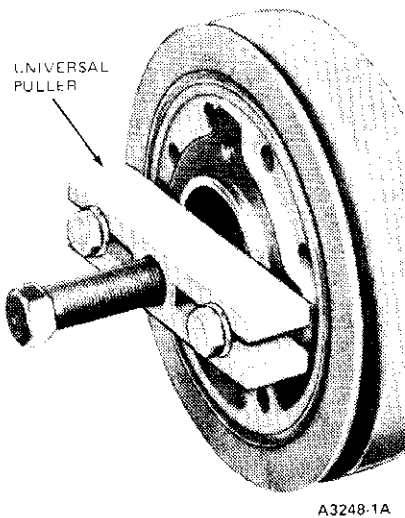


9. Connect the radiator lower hose at the water pump.
10. Connect the heater hose at the water pump.
11. Connect the battery cable. Fill and bleed the cooling system. Operate the engine until normal operating temperature has been reached and check for leaks.

CYLINDER FRONT COVER PLATE AND TIMING CHAIN

Removal

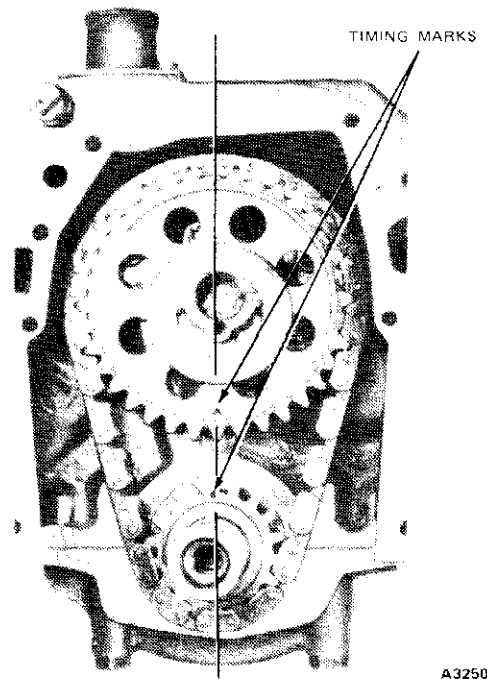
1. Refer to Water Pump Removal. Perform Steps 1 thru 9, but leave the water pump attached to the front cover plate.
2. Remove the heater hose and lower radiator hose from the water pump.
3. Remove the crankshaft pulley from the crankshaft vibration damper. Remove the vibration damper attaching screw. Install the puller on the crankshaft vibration damper (Fig. 19) and remove the vibration damper.



A3248-1A

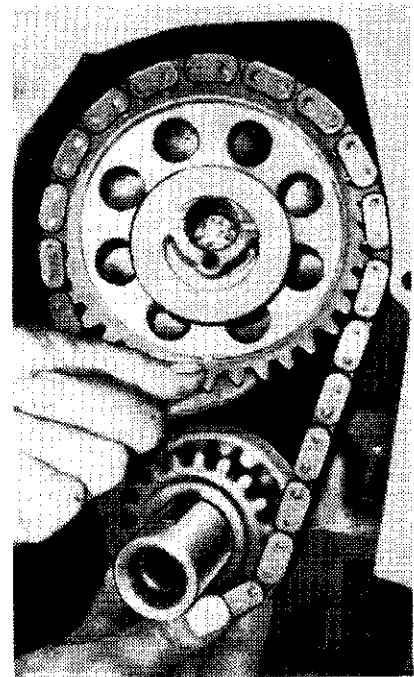
FIG. 19 Removing Crankshaft Vibration Damper

4. Remove the timing pointer.
5. Remove the bolts attaching the front cover plate and water pump to the cylinder block. Remove the front cover plate and water pump assembly.
6. Disconnect the fuel pump outlet line from the fuel pump. Remove the fuel pump attaching bolt and nut and lay the pump to one side with the flexible fuel line still attached.
7. Discard the cylinder front cover plate gasket and oil pan seal.
8. Check the timing chain deflection (refer to Part 21-01).
9. Crank the engine until the timing marks on the sprockets are positioned as shown in Fig. 20.
10. Remove the camshaft sprocket cap screw, washer and two piece fuel pump eccentric. Slide both sprockets and the timing chain forward, and remove them as an assembly (Fig. 21).



A3250-1A

FIG. 20 Aligning Timing Marks

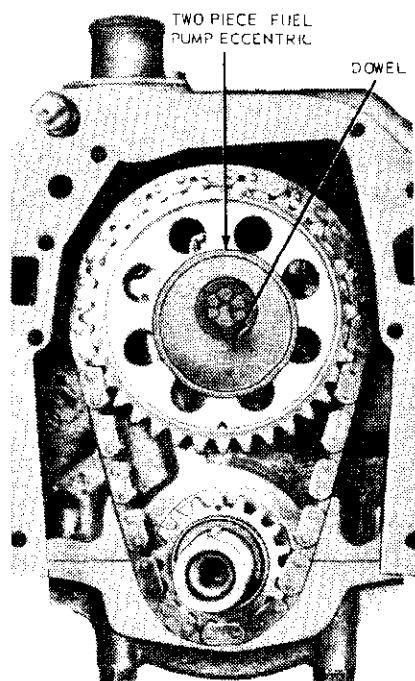


A3251-1A

FIG. 21 Removing or Installing Timing Chain

Installation

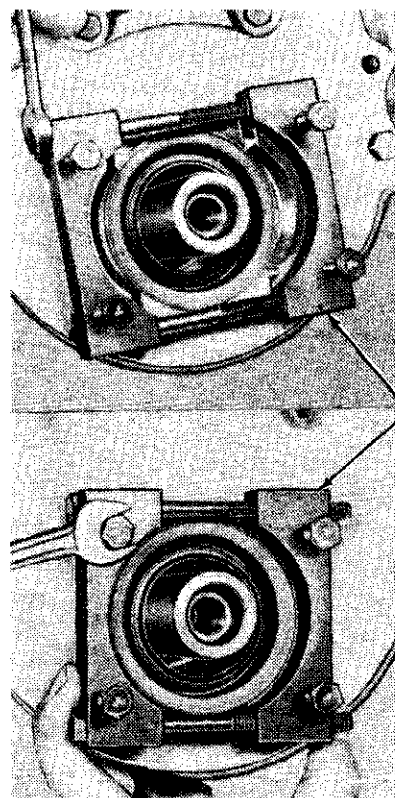
1. Position the sprockets and timing chain on the camshaft and crankshaft (Fig. 22). Be sure the timing marks on the sprockets are positioned as shown in Fig. 20.



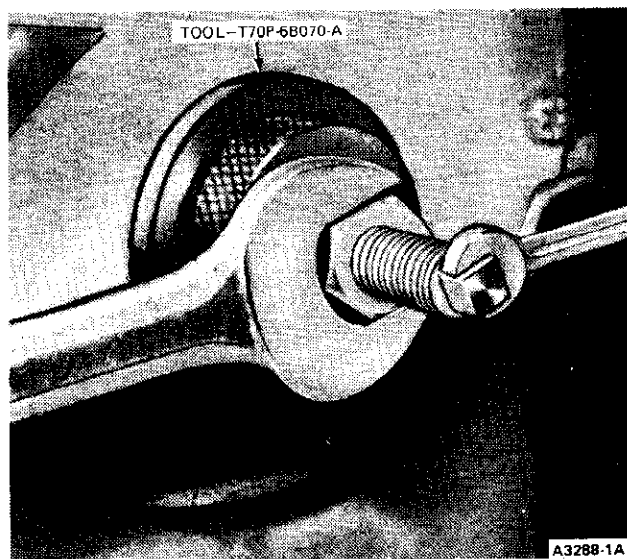
A3252-1B

FIG. 22 Fuel Pump Eccentric Installed

2. Install the two-piece fuel pump eccentric, washers and camshaft sprocket cap screw (Fig. 22). Torque the sprocket cap screw to specification. **Be sure the outer eccentric sleeve rotates freely.**
3. Coat a new fuel pump gasket with oil-resistant sealer and position the fuel pump and gasket on the cylinder block with pump arm resting on the eccentric outer sleeve. Install the pump attaching bolt and nut and tighten to specification. Connect the fuel pump outlet line.
4. Remove the front crankshaft seal from the cylinder front cover plate with the tool shown in Fig. 23. Clean the cylinder front cover plate and the engine block gasket surfaces.
5. Coat the gasket surfaces of the block and cover with sealer, and position a new gasket on the cylinder block alignment dowels.
6. Position the cylinder front cover plate and water pump assembly on the cylinder block alignment dowels.
7. Coat the threads of the attaching bolts with oil-resistant sealer and install the timing pointer and attaching bolts. Torque the bolts to specification.
8. Install the front crankshaft seal into the cylinder front cover plate with the tool shown in Fig. 24.
9. Apply Lubriplate or equivalent to the oil seal rubbing surface of the vibration damper inner hub to prevent damage to the seal. Apply a white lead and oil mixture to the front of the crankshaft for damper installation.
10. Line up the crankshaft vibration damper keyway with the key on the crankshaft. Install the vibration damper on the crankshaft using Tool T52L-6306-



A3249-1A

FIG. 23 Removing Crankshaft Front Seal**FIG. 24 Installing Front Crankshaft Seal**

- AEE (or 6306-AJ) (Fig. 25). Install the cap screw and washer. Tighten the cap screw to specification. Install the crankshaft pulley.
11. Connect the heater hose and the radiator lower hose at the water pump.
12. Refer to Water Pump Installation and complete Steps 3 thru 11 to install the necessary parts, fill and bleed the cooling system, etc.
13. Raise the vehicle. Remove the oil pan and install new gaskets and seals following procedures under Oil Pan Removal and Installation.

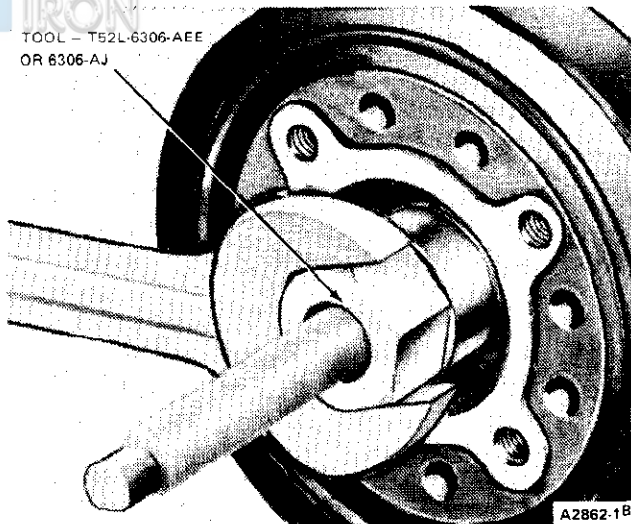


FIG. 25 Installing Crankshaft Vibration Damper

14. Lower the vehicle.
15. Fill the crankcase with the proper grade and quantity of engine oil. Fill and bleed the cooling system.
16. Connect the battery. Operate the engine until normal operating temperature has been reached and check for leaks.

FRONT OIL SEAL

Removal

1. Remove the bolts attaching the fan shroud to the radiator.
2. Remove the fan and spacer bolts from the water pump shaft. Remove the fan, spacer and shroud.
3. Loosen the alternator, power steering, Thermactor and air conditioner drive belts, if so equipped. Remove the drive belts.
4. Remove the crankshaft pulley from the vibration damper. Remove the damper attaching screw and washer. Install the puller on the crankshaft vibration damper (Fig. 19) and remove the vibration damper.

5. Place the front seal removing tool onto the front cover plate over the front seal as shown in Fig. 23. Tighten the two through bolts to force the seal puller under the seal flange.
6. Alternately tighten the four puller bolts a half turn at a time as shown in Fig. 23 to pull the oil seal from the front cover.

Installation

1. Coat a new front cover plate oil seal with Lubriplate or equivalent and place it onto the front oil seal alignment and installation sleeve as shown in Fig. 24. Place the sleeve and seal onto the end of the crankshaft and push it toward the engine until the seal starts into the front cover.
2. Place the installation screw, washer and nut onto the end of the crankshaft. Thread the screw into the crankshaft. Tighten the nut against the washer and installation sleeve to force the seal into the front cover plate. Remove the installation tool from the crankshaft.
3. Apply Lubriplate or equivalent to the oil seal rubbing surface of the vibration damper inner hub to prevent damage to the seal. Apply a white lead and oil mixture to the front of the crankshaft for damper installation.
4. Line up the crankshaft vibration damper keyway with the key on the crankshaft. Install the vibration damper on the crankshaft (Fig. 25). Install the cap screw and washer. Torque the screw to specification. Install the crankshaft pulley.
5. Install the alternator, power steering pump, Thermactor and air conditioner belts, if so equipped.
6. Position the fan shroud over the water pump pulley. Install the fan and spacer. Install the fan shroud attaching screws.
7. Adjust the drive belts to specification.

CAMSHAFT

The camshaft and related parts are shown in Fig. 26.

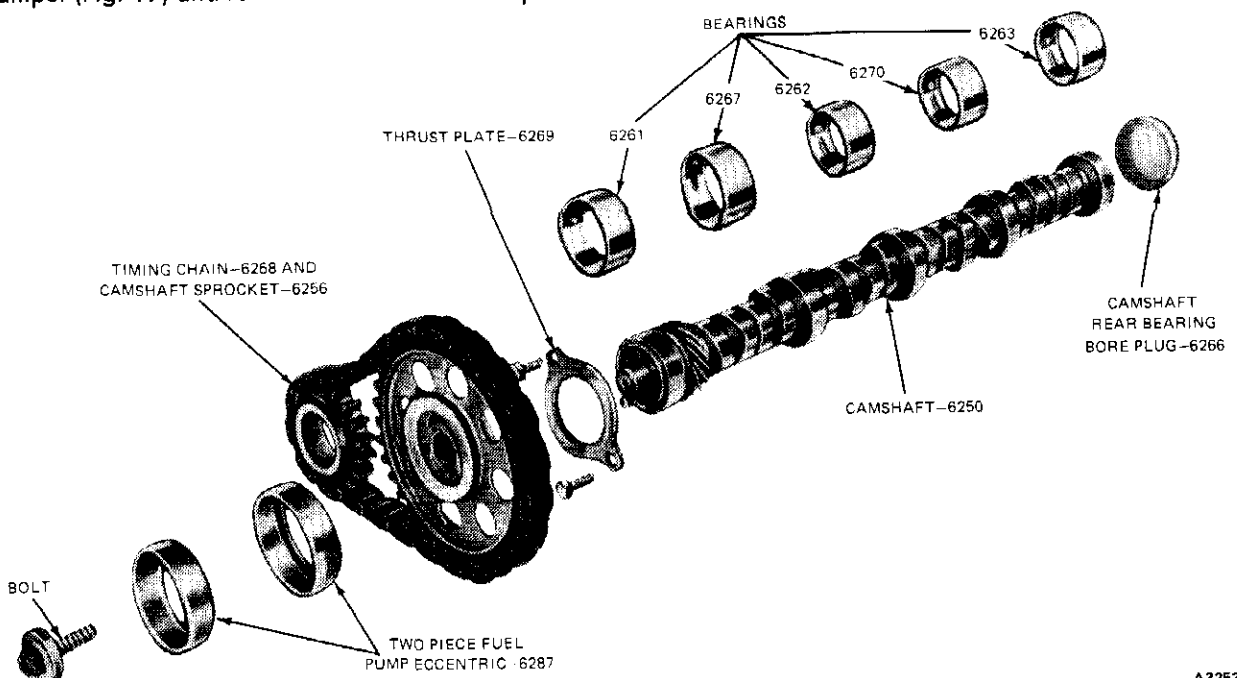


FIG. 26 Camshaft and Related Parts

A3253-2A

Removal

1. Drain the cooling system. Disconnect the upper and lower radiator hoses at the radiator. Disconnect the oil cooler lines at the radiator. If equipped with air conditioning, remove the condenser.
2. Remove the cylinder front cover plate, fuel pump and the timing chain following the procedure under the Cylinder Front Cover Plate and Timing Chain Removal.
3. Remove the intake manifold following the procedure under Intake Manifold Removal.
4. Remove the valve rocker arm covers. Loosen the valve rocker arm fulcrum bolts and rotate the rocker arms to the side.
5. Remove the valve push rods and identify them so that they can be installed in their original positions.
6. Using the tool shown in Fig. 16, remove the tappets and place them in a rack so that they can be installed in their original bores.

Rotate the tappet back and forth to loosen it from the gum or varnish that may have formed.

7. Be sure the Number 1 piston is in the TDC position and the distributor motor points at number one. Remove the camshaft thrust plate. Carefully remove the camshaft by pulling toward the front of the engine. **Use caution to avoid damaging the camshaft bearings.**

Installation

1. **Oil the camshaft journals and apply Lubriplate or equivalent to the lobes.** Carefully slide the camshaft through the bearings. Install the camshaft thrust plate onto the cylinder block. Install the timing sprockets and timing chain. Check camshaft end play as shown in Part 21-01.
2. Install the tappets in the bores from which they were removed.
3. Install fuel pump, cylinder front cover plate and related parts following steps 1 thru 13 under Cylinder Front Cover Plate and Timing Chain Installation.
4. Adjust the drive belts to specification.
5. Install the push rods in their original positions.
6. Install the rocker arms following the procedure given in Rocker Arm Installation.
7. Install the rocker arm covers following the procedure given in Rocker Arm Cover Installation.
8. Install the intake manifold, distributor and related parts by following procedures under Intake Manifold Installation.
9. Connect the accelerator cable and retracting spring. Connect the transmission downshift rod if so equipped. Install the vacuum lines that were disconnected from the intake manifold during removal.
10. Clean and install the crankcase ventilation system.
11. Install the distributor cap. Position the spark plug wires in the harness brackets on the valve rocker arm covers and connect the wires to the plugs. Connect the high tension lead at the coil.
12. If equipped with air conditioning, install the condenser.

13. Place the radiator shroud over the fan. Install the radiator and connect the hoses. Connect the transmission oil cooler lines at the radiator. On vehicles so equipped, install the radiator shroud attaching bolts.
14. Raise the vehicle. Remove the oil pan and install new gaskets and seals following procedures under Oil Pan Removal and Installation.
Lower the vehicle. Install the fan shroud attaching bolts.
15. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.
16. Start the engine and check and adjust the ignition timing. Connect the distributor vacuum lines.
17. Operate the engine at fast idle and check all hose connections and gaskets for leaks. When the engine temperature has stabilized adjust the engine idle speed and idle fuel mixture.
18. Install the air cleaner and intake duct assembly.

FLYWHEEL

Removal

1. Remove the transmission and converter housing following the procedure in Group 17.
2. To check ring gear for lateral run-out, refer to Part 21-01.
3. Remove the flywheel attaching bolts and remove the flywheel.

Installation

1. Coat the threads of the flywheel attaching bolts with oil-resistant sealer. Position the flywheel on the crankshaft flange. Install and torque the bolts in sequence (across from each other) to specification.
2. Check the flywheel lateral runout, following the procedure in Part 21-01, and install the transmission and converter housing following the procedure in Group 17.

CAMSHAFT REAR BEARING BORE PLUG

Removal

1. Remove the transmission and converter housing following the procedure in Group 17.
2. Remove the flywheel attaching bolts and remove the flywheel. Remove the engine rear cover plate.
3. Remove the bore plug as detailed in Part 21-01 under Core Plugs.

Installation

1. Using Tool T70P-6011-A, install the bore plug as outlined in Part 21-01.
2. Coat the flywheel attaching bolts with oil-resistant sealer. Position the engine rear cover plate on the cylinder block dowels. Position the flywheel on the crankshaft flange. Install and torque the attaching bolts in sequence (across from each other) to specification.

Install the transmission and converter housing following the procedure in Group 17.

OIL PAN

Removal

1. Disconnect the battery cable. Remove the oil level dipstick.

2. Remove the fan shroud attaching bolts and position the fan shroud and air inlet tube over the fan.
3. Raise the vehicle.
4. Drain the crankcase.
5. Remove the sway bar attaching bolts from the chassis and lower the sway bar for clearance (except Ford and Mercury).
6. Remove the engine front support through bolts.
7. Raise the engine and place wood blocks between the engine supports and chassis brackets.
8. Remove the oil pan attaching bolts.
9. Position the transmission fluid cooler lines out of the way.
10. Lower the oil pan. Loosen the oil pump and inlet tube and let the assembly drop into the pan. Position the rear crankshaft throw horizontally to permit oil pan removal.
11. Remove the oil pan.

Installation

1. Clean the gasket surfaces of the block and oil pan. The oil pan has a two-piece gasket.
2. Clean the oil pump pick-up tube and screen.
3. Coat the block surface and the oil pan gasket with contact cement (B9AE-19B508-A or equivalent). Position the oil pan gaskets on the cylinder block (Fig. 27).

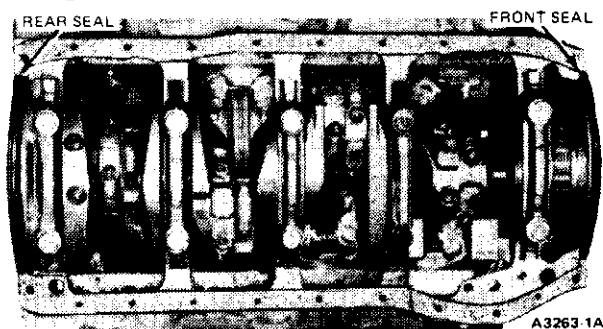


FIG. 27 Oil Pan Gasket and Seals Installed—Typical

4. Position the oil pan front seal on the cylinder front cover plate. Be sure the tabs on the seal are over the oil pan gasket.
5. Position the oil pan rear seal on the rear main bearing cap (Fig. 27). Be sure the tabs on the seal are over the oil pan gasket.
6. Place the oil pump and intake tube in position in the oil pan and position the oil pan under the engine. Install the oil pump and intake tube and torque the attaching bolts to specification. Position the oil pan against the block and install a bolt, finger tight, on each side of the block. Install the remaining bolts. Tighten the bolts from the center outward in each direction to specification.
7. Raise the engine and remove the wood blocks from between the engine supports and chassis brackets. Lower the engine and install the engine support through bolts. Tighten the bolts to specification.
8. Install the sway bar to chassis attaching bolts (except Ford and Mercury).
9. Install the starter and connect the starter cable.

10. Lower the vehicle.
11. Install the fan shroud and air inlet tube attaching bolts.
12. Install the oil level dipstick. Fill the crankcase with the proper grade and quantity of engine oil. Start the engine and operate at idle speed until it reaches normal operating temperature. Check for oil leaks.

OIL PUMP

Removal

1. Remove the oil pan and related parts as outlined under Oil Pan Removal.
2. Remove the oil pump attaching bolts and remove the oil pump with pick up tube and screen, gasket and intermediate drive shaft.

Installation

1. Clean and install the oil pump inlet tube and screen assembly (Fig. 28).

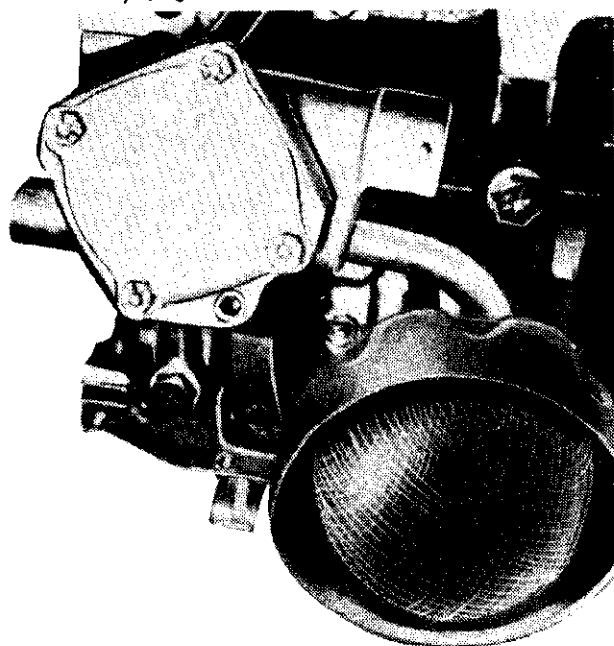


FIG. 28 Oil Pump and Inlet Tube Installed

2. Prime the oil pump by filling either the inlet or outlet port with engine oil. Rotate the pump shaft to distribute the oil within the pump body.
3. Position the intermediate drive shaft into the distributor socket. With the shaft firmly seated in the distributor socket, the stop on the shaft should touch the roof of the crankcase. Remove the shaft and position the stop as necessary.
4. With the stop properly positioned, insert the intermediate drive shaft into the oil pump. Install the pump and shaft as an assembly.

Do not attempt to force the pump into position if it will not seat readily. The drive shaft hex may be misaligned with the distributor shaft. To align, rotate the intermediate drive shaft into a new position.

Tighten the oil pump attaching screws to specification. Be sure the oil pick up screen is parallel with the oil pan mounting surface.

5. Install the oil pan and related parts as outlined under Oil Pan Installation.

CRANKSHAFT REAR OIL SEAL

A split-up type crankshaft rear oil seal is used for replacement on all engines. If replacement is necessary, this type of seal must be used. The complete seal can be replaced without removing the crankshaft. Refer to Part 21-01 for removal and installation procedures.

MAIN BEARING INSERTS

Main bearing inserts are selective fits. Do not file or lap bearing caps or use bearing shims to obtain proper clearance.

Selective fit bearings are available for service in standard size, 0.001 and 0.002 inch undersize. Undersize bearings (0.010, 0.020, 0.030 and 0.040 inch) which are not selective fit, are available for use on crankshaft journals that have been refinished.

Removal

1. Drain the crankcase. Remove the oil level dipstick. Remove the oil pan and related parts.
2. Remove the oil pump and inlet tube assembly.
3. Replace one bearing at a time, leaving the other bearings securely fastened.

Remove the main bearing cap to which new bearing inserts are to be installed.

4. Insert the upper bearing removal tool (Tool 6331) in the oil hole in the crankshaft.
5. Rotate the crankshaft in the direction of the engine rotation to force the bearing insert out of the block.
6. If the rear main bearing is being replaced, remove and discard the rear oil seal from the bearing cap.

Loosen all main bearing bolts, thereby lowering the crankshaft slightly but not to exceed 1/32 inch. Remove the block half of the rear oil seal. Use a seal removal tool or install a small metal screw in one end of the seal, and pull on the screw to remove the seal. **Be careful not to burr the crankshaft seal rubbing surface.**

Installation

1. If the rear main bearing is being replaced, clean the rear oil seal groove in the block with a brush and solvent.

Carefully install the upper seal (split lip type) into its groove with the undercut side of the seal toward the FRONT of the engine by rotating it on the seal journal of the crankshaft until approximately 3/8 inch protrudes below the parting surface. **Be sure no rubber has been shaved from the outside diameter of the seal by the bottom edge of the groove. Tighten the bolts on main bearings 1, 2, 3 and 4, thereby raising the crankshaft to its original position. Torque the bolts to specification.**

2. Clean the crankshaft journals. Inspect the journals and thrust faces (thrust bearing) for nicks, burrs or bearing pick-up that would cause premature bearing wear.
3. To install the upper main bearing insert, place the plain end of the bearing insert over the shaft on the locking tang side of the block and partially

install the bearing insert so that Tool 6331 can be inserted in the oil hole in the crankshaft. With Tool 6331 positioned in the oil hole in the crankshaft, rotate the crankshaft in the opposite direction of engine rotation until the bearing insert seats itself. Remove the tool.

4. Replace the cap bearing.
5. Select fit the bearing for proper clearance following procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. If the bearing insert is being replaced on journal number 1, 2 or 4, apply a light coat of engine oil to the journal and bearing inserts and install the bearing cap. Tighten the cap bolts to specification.
7. If the rear main bearing is being replaced, clean the oil seal groove with a brush and solvent.
8. Install the lower seal in the rear main bearing cap with undercut side of seal toward the FRONT of the engine allow the seal to protrude approximately 3/8 inch above the parting surface to mate with the upper seal when the cap is installed.
9. Refer to Part 21-01 for special instructions in applying sealer to the rear main bearing cap. Lubricate the journal with engine oil and install the rear main bearing cap. Tighten the cap bolts to specification.
10. If the thrust bearing cap (No. 3 main bearing) has been removed, install it as follows:

Lubricate the journal with engine oil and install the thrust bearing cap with the bolts finger tight. Pry the crankshaft forward against the thrust surface of the upper half of the bearing. (See Fig. 34.) Hold the crankshaft cap to the rear. This will align the thrust surfaces of both halves of the bearing. Retain the forward pressure on the crankshaft. Torque the cap bolts to specification.

11. Clean the oil pump inlet tube screen. Prime the pump by filling the inlet opening with oil and rotate the pump shaft until oil emerges from the outlet opening. Install the oil pump and the inlet tube assembly.
12. Position the oil pan gaskets on the oil pan. Position the oil pan front seal on the cylinder front cover. Position the oil pan rear seal on the rear main bearing cap. Install the oil pan and related parts. Install the oil level dipstick.
13. Fill the crankcase with proper grade of oil. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil leaks.

CONNECTING ROD BEARING INSERTS

The connecting rod bearings are selective fit. Refer to procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.

Removal

1. Drain the crankcase oil. Remove the oil level dipstick. Remove the oil pan and related parts.
2. Remove the oil pump and inlet tube assembly.
3. Turn the crankshaft until the connecting rod to which new bearings are to be fitted is down. Remove the connecting rod cap. Remove the bearing inserts from the rod and cap.

Installation

1. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure.
2. Clean the crankshaft journal.
3. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.
4. Pull the connecting rod assembly down firmly on the crankshaft journal.
5. Select fit the bearing following procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. After the bearing has been fitted, clean and apply a light coat of engine oil to the journal and bearings. Install the connecting rod cap. Torque to specification.
7. Clean the oil pump inlet tube screen. Prime by filling the inlet opening with oil and rotate the pump shaft until oil emerges from the outlet opening. Install the oil pump and the inlet tube assembly.
8. Position the oil pan gaskets on the oil pan. Position the oil pan front seal on the cylinder front cover plate. Position the oil pan rear seal on the rear main bearing cap. Install the oil pan and related parts. Install the oil level dipstick.
9. Fill the crankcase. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil leaks.

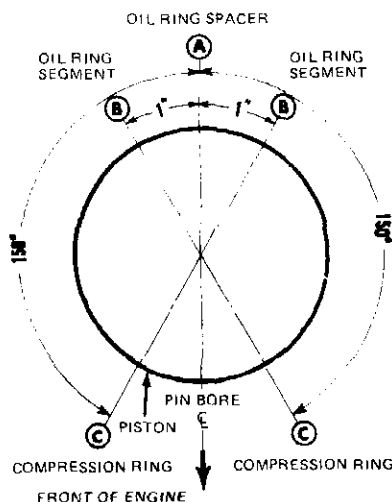
PISTONS AND CONNECTING RODS

Removal

1. Drain the cooling system and the crankcase. Remove the intake manifold, cylinder heads, oil pan and oil pump, following the procedures in this section.
2. Remove any ridges and/or deposits from the upper end of the cylinder bores as follows:
Turn the crankshaft until the piston to be removed is at the bottom of its travel and place a cloth on the piston head to collect the cuttings. Remove any ridge and/or deposits from the upper end of the cylinder bores. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturers. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.**
3. Make sure all connecting rod caps are marked so that they can be installed in their original positions.
4. Turn the crankshaft until the connecting rod being removed is down.
5. Remove the connecting rod nuts and cap.
6. Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. **Avoid damage to the crankshaft journal or the cylinder wall when removing the piston and rod.**
7. Remove the bearing inserts from the connecting rod and cap.
8. Install the cap on the connecting rod from which it was removed.

Installation

1. If new piston rings are to be installed, remove the cylinder wall glaze using a spring type cylinder hone only if there is no visible sign of cross hatch markings on cylinder walls. Follow the instructions of the tool manufacturer. After deglazing or honing cylinder walls, clean bore with a detergent and water solution.
2. Oil the piston rings, pistons and cylinder walls with light engine oil. **Be sure to install the pistons in the same cylinders from which they were removed or to which they were fitted. The connecting rod and bearing caps are numbered from 1 to 4 in the right bank and from 5 to 8 in the left bank, beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.**
3. Make sure the ring gaps are properly spaced around the circumference of the piston (Fig. 29).



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FIG. 29 Piston Ring Spacing

4. Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is slightly below the top of the cylinder (Fig. 30). Be sure to guide the connecting rods to avoid damaging the crankshaft journals. **Install the piston with the arrow on the piston head toward the front of the engine (Fig. 31).**
5. Check the clearance of each bearing following the procedure under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.
7. Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the connecting rod bearing seats on the crankshaft journal.
8. Install the connecting rod cap and bearing. Torque the nuts to specification.

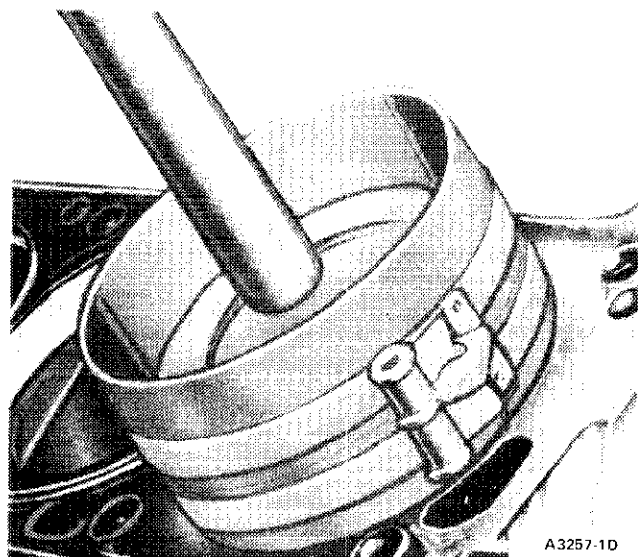


FIG. 30 Installing Piston

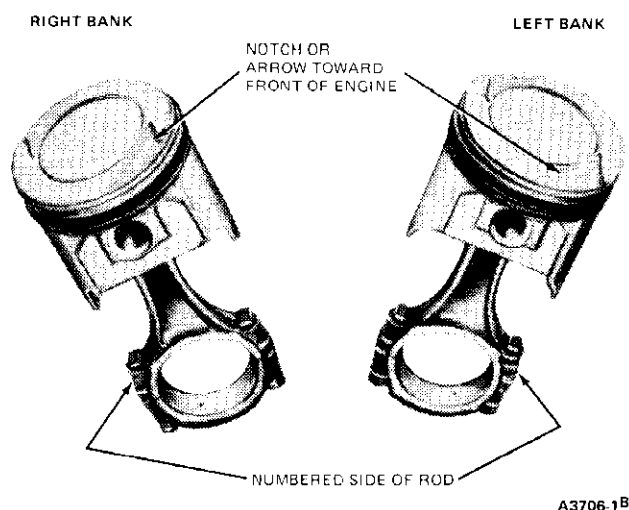


FIG. 31 Correct Piston and Rod Positions

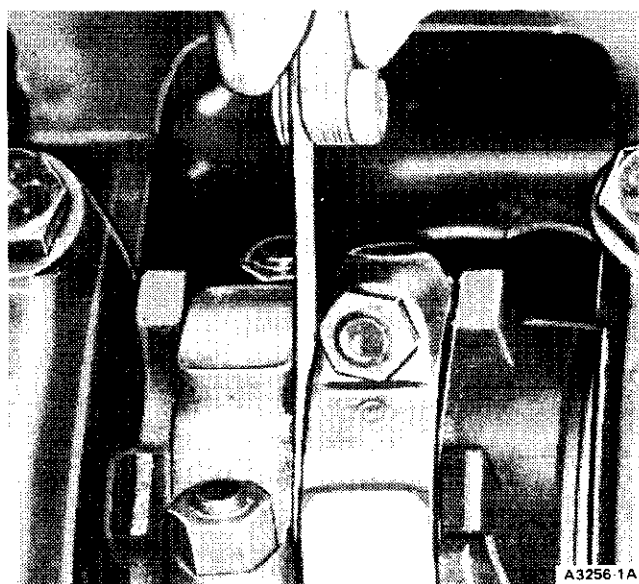


FIG. 32 Checking Connecting Rod Side Clearance

9. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each crankshaft journal (Fig. 32).
10. Disassemble, clean and assemble the oil pump (see Part 21-01). Clean the oil pump inlet tube screen and the oil pan and block gasket surfaces.
11. Prime the oil pump by filling either the inlet port or outlet port with engine oil and rotating the pump shaft to distribute the oil within the housing. Install the oil pump and the oil pan.
12. Install the cylinder heads following procedures under Cylinder Head Installation.
13. Install the intake manifold following procedures under Intake Manifold Installation.
14. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.
15. Start the engine and check and adjust the ignition timing. Connect the distributor vacuum hoses at the distributor.
16. Operate the engine at fast idle until it reaches normal operating temperature and check for oil and coolant leaks. When the engine temperature has stabilized adjust the engine idle speed and idle fuel mixture.
17. Install the air cleaner and inlet tube assembly.

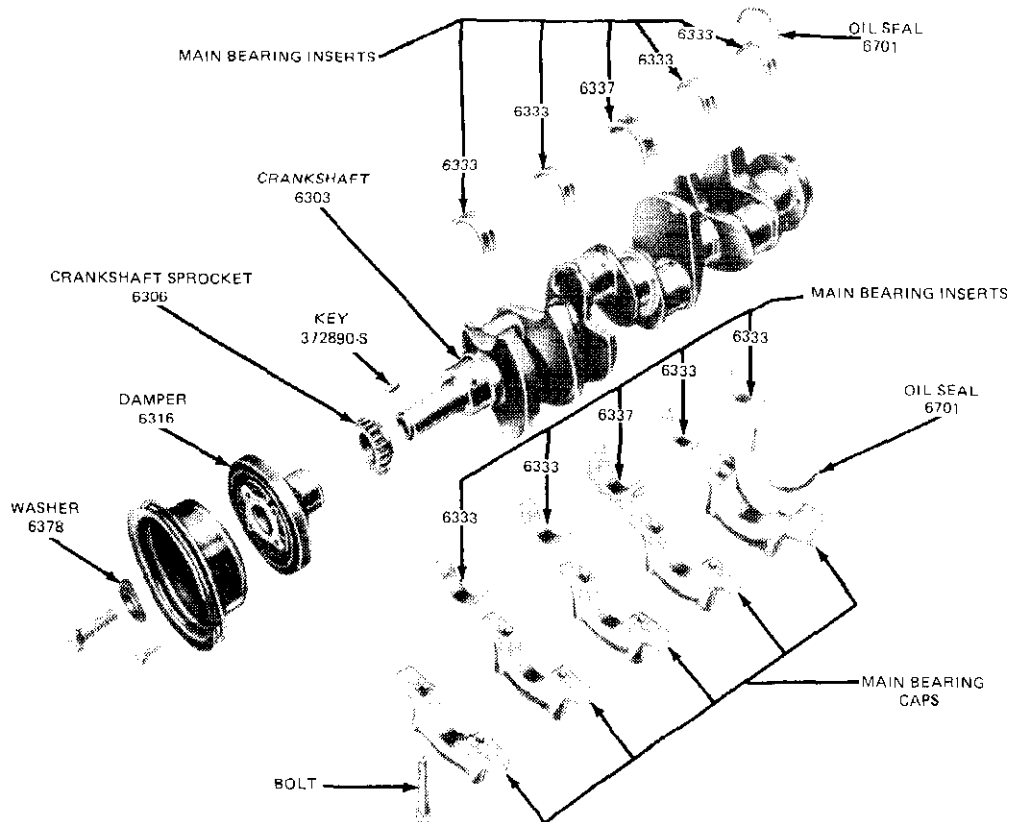
CRANKSHAFT

The crankshaft and related parts are shown in Fig. 33.

Removal

1. With engine removed from vehicle and placed on a work stand, disconnect the spark plug wires at the spark plugs and remove the wires from the ignition harness brackets on the valve rocker arm covers. Disconnect the coil-to-distributor cap and spark plug wires. Remove the spark plugs to allow easy rotation of the crankshaft.
2. Disconnect the fuel pump outlet line at the pump. Remove the fuel pump from the cylinder block. Remove the alternator and mounting brackets.
3. Remove the crankshaft pulley from the crankshaft vibration damper. Remove the cap screw and washer from the end of the crankshaft. Install the puller on the crankshaft vibration damper (Fig. 19) and remove the damper.
4. Remove the timing pointer. Remove the water pump and cylinder front cover plate as an assembly. Discard the gasket.
5. Check the timing chain deflection (Refer to Part 21-01). Remove the camshaft sprocket cap screw, washer and two piece fuel pump eccentric. Slide both sprockets and the timing chain forward and remove them as an assembly (Fig. 21).
6. Invert the engine on the work stand. Remove the flywheel and engine rear cover plate. Remove the oil pan and gasket. Remove the oil pump.
7. Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in their original locations.

Turn the crankshaft until the connecting rod from which the cap is being removed is down, and



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FIG. 33 Crankshaft and Related Parts

remove the bearing cap. Push the connecting rod and piston assembly up into the cylinder. Repeat this procedure until all the connecting rod bearing caps are removed.

8. Remove the main bearing caps.
9. Carefully lift the crankshaft out of the block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.** To refinish journals, dress minor imperfections, etc., refer to Part 21-01.

Installation

1. Remove the rear journal oil seal from the block and rear main bearing cap.
2. Remove the main bearing inserts from the block and bearing caps.
3. Clean the rear journal oil seal groove and the mating surfaces of the block and rear main bearing cap.
4. Remove the connecting rod bearing inserts from the connecting rods and caps.
5. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. If not, it will be necessary to select-fit new gearing inserts using the Plastigage Method. (See Part 21-01). Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts will distort the bearing and cause a failure.
6. Place the upper main bearing inserts in position in the bores with the tang fitting in the slot provided.
7. Install the lower main bearing inserts in the bearing caps.

8. Dip the lip seal halves in clean engine oil. Install the lip seals in the bearing cap and block with the undercut side of the seal toward the FRONT of the engine.
9. Carefully lower the crankshaft into place. **Be careful not to damage the bearing surface.**
10. If main bearings were not refinished to a standard undersize, check the clearance of each main bearing following the procedure under Fitting Main and Connecting Rod Bearings in Part 21-01.
11. After the bearings have been fitted, apply sealer to the rear main bearing cap, following the instructions given in Part 21-01 for use of silicone rubber sealer in this area.
12. Apply heavy engine oil SE to the journals and bearings.
13. Install the rear main bearing cap with the rear surface flush or slightly ahead of the rear of the cylinder block. Install all bearing caps, except the thrust bearing cap (No. 3 bearing). **Be sure that the main bearing caps are installed in their original locations.**
Torque the bearing cap bolts to specification.
14. Install the thrust bearing cap with the bolts finger tight.
15. Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 34).
16. Hold the crankshaft forward and pry the thrust bearing cap to the rear. This will align the thrust surfaces of both halves of the bearing.
17. Retain the forward pressure on the crankshaft. Tighten the cap bolts to specification.
18. Force the crankshaft toward the rear of the engine.

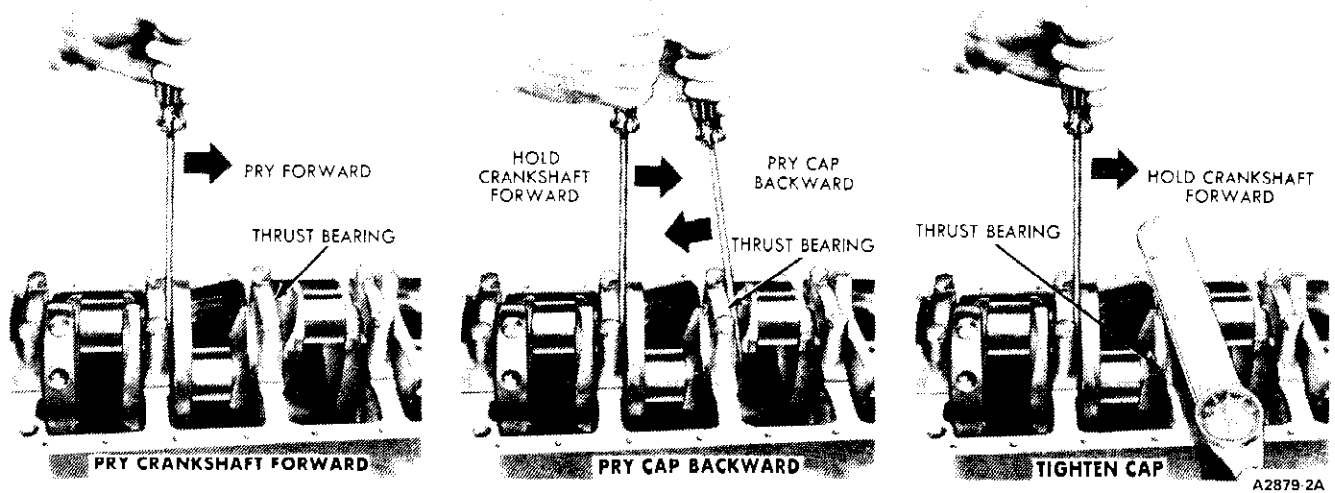


FIG. 34 Aligning Thrust Bearing

19. Check the crankshaft end play (Refer to Part 21-01).
20. Install the timing chain and sprockets, cylinder front cover plate and fuel pump, following steps 1 thru 8 under Cylinder Front Cover Plate and Timing Chain Installation.
21. Install the engine rear cover plate onto the alignment dowels at the rear of the cylinder block.
22. Coat the threads of the flywheel attaching bolts with oil-resistant sealer. Position the flywheel on the crankshaft flange. Install and tighten the bolts to specification.
23. Install new bearing inserts in the connecting rods and caps. Check the clearance of each bearing following the procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
24. After the connecting rod bearings have been fitted, apply a light coat of engine oil to the journals and bearings.
25. Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the rod bearing seats on the crankshaft journal.
26. Install the connecting rod cap. Torque the nuts to specification.
27. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each connecting rod crankshaft journal (Fig. 32).
28. Clean the oil pan, oil pump and oil pump screen. Prime the oil pump by filling either the inlet or outlet port with engine oil and rotating the pump shaft to distribute oil within the housing. Install the oil pump and oil pan by following the procedures under Oil Pan and Oil Pump Installation.
29. Install the front oil seal, vibration damper and crankshaft pulley, following Steps 10 thru 12 under Cylinder Front Cover Plate and Timing Chain Installation.
30. Install the spark plugs, distributor cap and spark plug wires. Refer to Part 23-01 for special installation instructions. Connect the spark plug wires and high tension lead.

31. Install the engine in the vehicle.

CAMSHAFT BEARING

Camshaft bearings are available prefinished to size for standard and 0.015 inch undersize journal diameters. The bearings are not interchangeable from one bore to another.

Removal

1. Remove the engine from the vehicle. Remove the camshaft, flywheel and crankshaft, following the appropriate procedures in this part. Push the pistons to the top of the cylinders.
2. Remove the camshaft rear bearing bore plug. (See Core Plugs in Part 21-01.) Remove the camshaft bearings (Fig. 35).

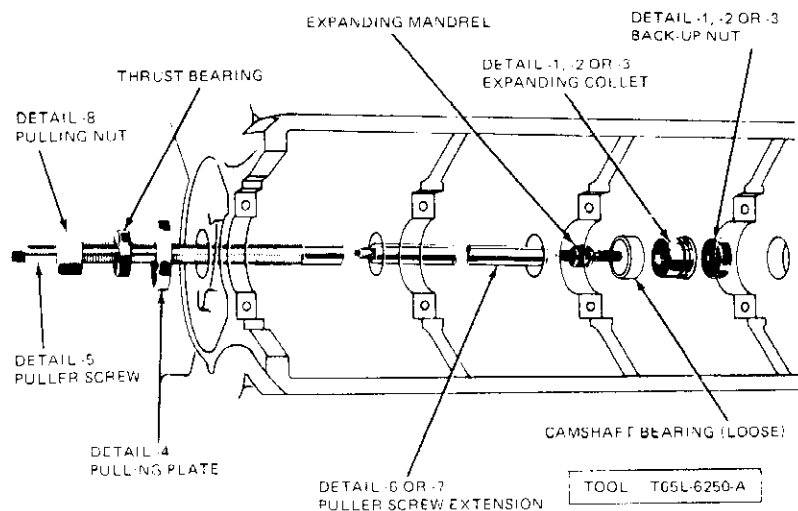


FIG. 35 Camshaft Bearing Replacement

3. Select the proper size expanding collet and back-up nut and assemble on the expanding mandrel. With the expanding collet collapsed, install the

collet assembly in the camshaft bearing, and tighten the back-up nut on the expanding mandrel until the collet fits the camshaft bearing.

4. Assemble the puller screw and extension (if necessary) as shown and install on the expanding mandrel. *Wrap a cloth around the threads of the puller screw to protect the front bearing or journal.* Tighten the pulling nut against the thrust bearing and pulling plate to remove the camshaft bearing. Be sure to hold a wrench on the end of the puller screw to prevent it from turning.
5. Repeat the procedure for each bearing. To remove the front bearing, install the puller screw from the rear of the cylinder block.

Installation

1. Position the new bearings at the bearing bores with the oil holes aligned, and press them in place with the tool shown in Fig. 35. Be sure to center the pulling plate and puller screw to avoid damage to the bearing. **Failure to use the correct**

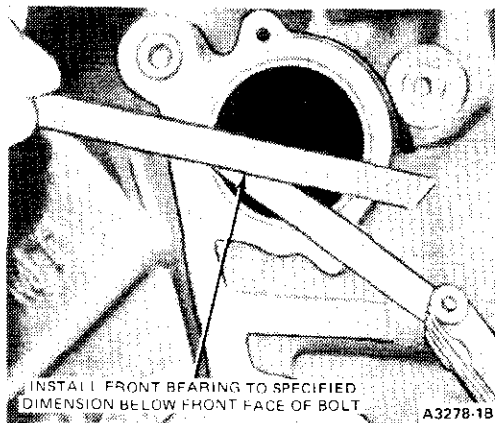


FIG. 36 Camshaft Front Bearing Measurement

DISASSEMBLY AND ASSEMBLY

When installing nuts or bolts that must be torqued (refer to torque specification), oil the threads with light weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.** Refer to Part 21-01, for cleaning and inspection procedures.

CYLINDER HEAD

Disassembly

1. Remove the exhaust manifolds, the spark plugs and spark plug wire shields.
2. Clean the carbon out of the cylinder head combustion chambers before removing the valves.
3. Compress the valve springs (Fig. 38). Remove the spring retainer locks and release the spring.
4. Remove the spring retainer, spring and stem seal. Discard the valve stem seals. **Remove any burrs from the valve stem with tool T70P-6505-A as**

expanding collet can cause severe bearing damage. Be sure the front bearing is installed the specified distance below the front face of the cylinder block (Fig. 36).

2. Install the core plug as detailed in Part 21-01.
3. Install the camshaft, crankshaft, flywheel and related parts, following the appropriate procedures in this section except do not check connecting and main bearing clearances as a part of Camshaft Bearing Replacement. Install the engine in the vehicle.

OIL FILTER

The oil filter assembly is shown in Fig. 38.

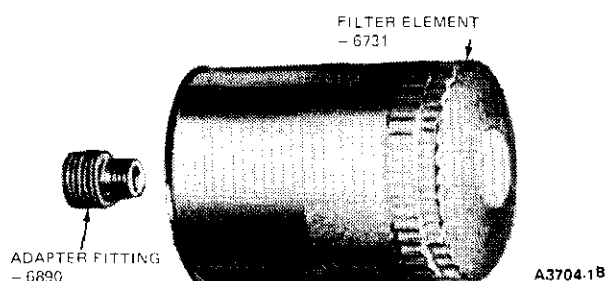


FIG. 37 Oil Filter Installation

Removal

Place a drip pan under the filter. Unscrew the filter from the adapter fitting using a filter wrench and clean the adapter recess.

Installation

1. Coat the gasket on a new filter with oil. Place the new filter in position on the adapter fitting. Hand tighten the filter until the gasket contacts the sealing surface, and then advance it 1/2 turn.
2. Operate the engine at fast idle, and check for oil leaks. If oil leaks are evident, perform the necessary repairs to correct leakage. Check the oil level and fill the crankcase if necessary.

shown in Fig. 39 to prevent damage to the valve guide bore. Remove the valve. Identify all valve parts.

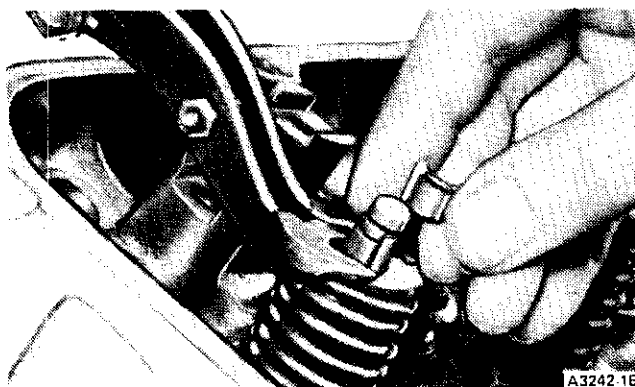


FIG. 38 Compressing Valve Spring

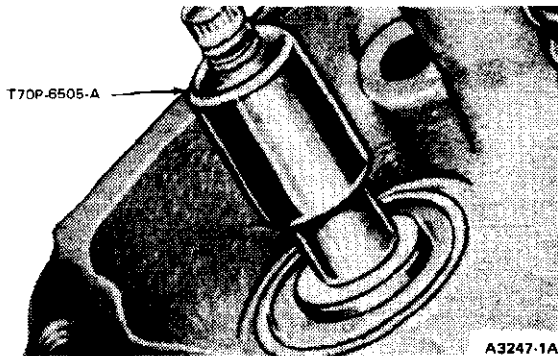


FIG. 39 Removing Valve Stem Burrs

5. Clean, inspect and repair the cylinder head as required, or transfer all usable parts to a new cylinder head.

Assembly

All valves, valve stems and valve guides are to be lubricated with heavy engine oil SE. The valve tips are to have Lubriplate or equivalent applied. The lubricant is to be applied before installation.

1. Clean the spring retainer lock grooves on the valves to remove any loose material left by the valve stem deburring tool.
2. Lubricate the valve guide and valve stem with heavy engine oil SE.
3. Install each valve (Fig. 40) in the port from which it was removed or to which it was fitted. Install a new stem seal on the valve. Use a 5/8-inch deep wall socket and a light hammer or mallet to seat the seal on the valve system.

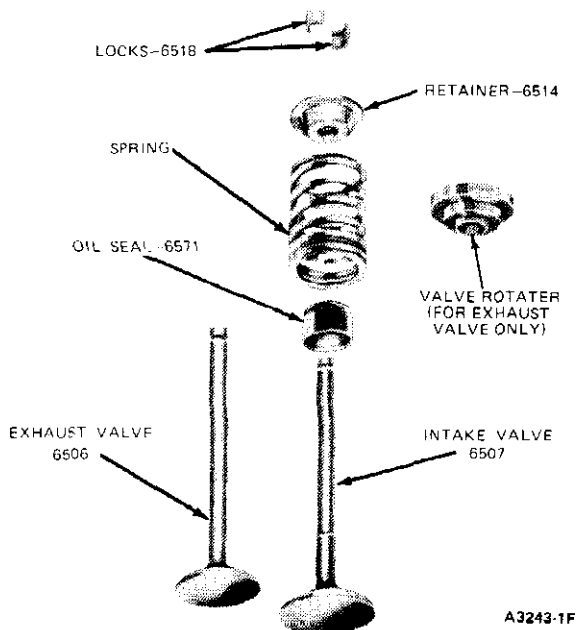


FIG. 40 Valve and Related Parts

4. Install the valve spring over the valve, and then install the spring retainer. Compress the spring and install the retainer locks (Fig. 40).
5. Measure the assembled height of the valve spring from the surface of the cylinder head spring pad

to the underside of the spring retainer with dividers (Fig. 41). Check the dividers against a scale. If the assembled height is greater than specification, install the necessary 0.030 inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended height. **Do not install the spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve springs and over-loading the camshaft lobes which could lead to spring breakage and/or worn camshaft lobes.**

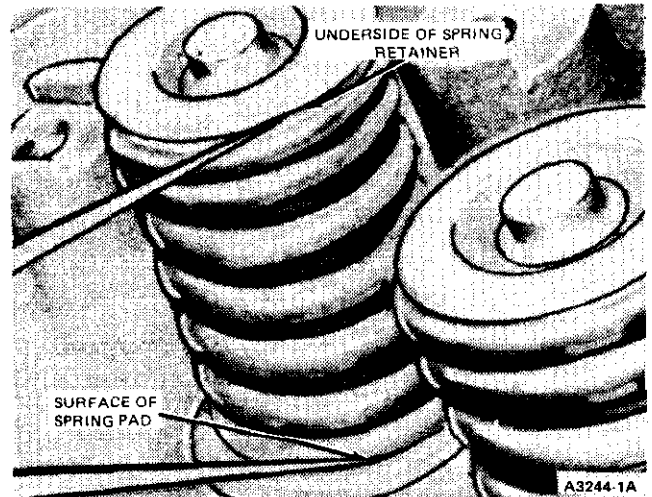


FIG. 41 Valve Spring Assembled Height

6. Install the exhaust manifolds and the spark plugs.

HYDRAULIC TAPPET

The internal parts of each hydraulic tappet assembly are matched sets. **Do not intermix the parts. Keep the assemblies intact until they are to be cleaned.**

Tappets should always be tested after assembly; refer to the procedures covered in Part 21-01 for cleaning, inspection and testing.

Disassembly

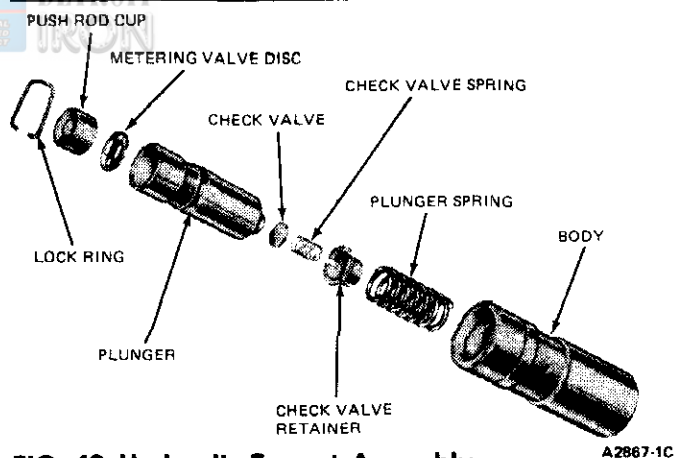
Disassemble and assemble each tappet separately. Identify the tappet assemblies so they can be installed in their original bores.

1. Grasp the lock ring with needle nose pliers to release it from the groove. It may be necessary to depress the plunger to fully release lock ring.
2. Remove the push rod cup, metering valve (disc), plunger and spring.
3. Remove the plunger assembly, the check valve and the check valve retainer and plunger spring. Carefully remove the plunger spring, the check valve retainer and, the check valve disc from the plunger.

Assembly

Hydraulic tappet assembly is shown in Fig. 42.

1. Place the plunger upside down on a clean work bench.
2. Place the check valve (disc or ball check) in position over the oil hole on the bottom of the plunger. Set the check valve spring on top of the check valve (disc or ball check).

**FIG. 42 Hydraulic Tappet Assembly**

3. Position the check valve retainer over the check valve and spring and push the retainer down into place on the plunger.
4. Place the plunger spring, and then the plunger (open end up) into the tappet body.
5. Position the metering valve (disc) in the plunger, and then place the push rod cup in the plunger.
6. Depress the plunger, and position the closed end of the lock ring in the groove of the tappet body. With the plunger still depressed, position the open ends of the lock ring in the groove. Release the plunger, and then depress it again to fully seat the lock ring.
7. Use the hydraulic tappet leakdown tester (Part 21-01) to fill the tappets with test fluid.

PISTON AND CONNECTING ROD

Disassembly

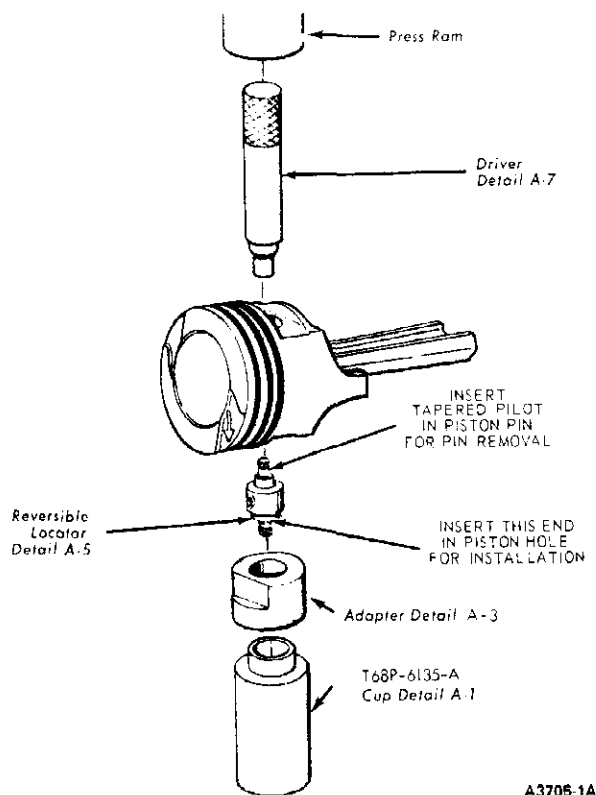
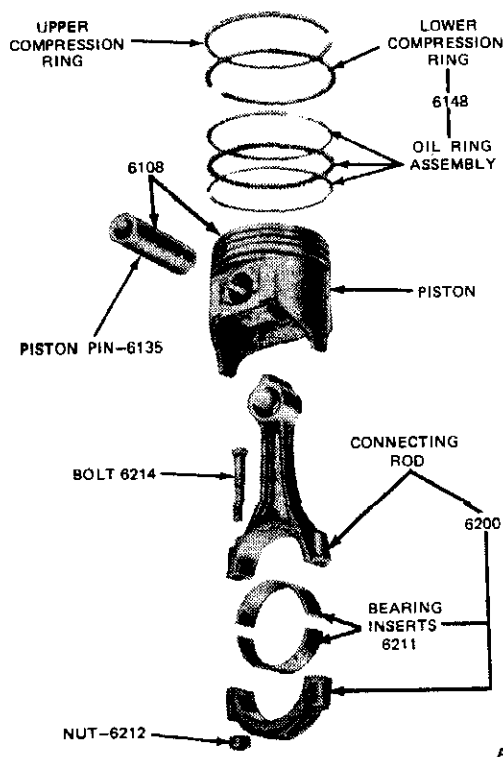
1. Remove the bearing inserts from the connecting rod and cap.
2. Mark the pistons to assure assembly with the same rod and installation in the same cylinders from which they were removed.
3. Remove the piston rings. Using an arbor press and the tool shown in Fig. 43, press the piston pin from the piston and connecting rod.

Assembly

The piston connecting rod and related parts are shown in Fig. 44. **Check the fit of a new piston in the cylinder bore before assembling the piston and piston pin to the connecting rod.**

The piston pin bore of a connecting rod and the diameter of the piston pin must be within specification.

1. Apply a light coat of engine oil to all parts. Assemble the piston to the connecting rod with the cylinder number side of the connecting rod and the arrow on the piston positioned as shown in Fig. 31. On replacement connecting rods, install the large-chamfered side of the connecting rod bearing bore towards the crankshaft cheek; facing towards front of engine on right bank rods, and facing towards rear of engine on left bank rods.
2. Start the piston pin in the piston and connecting rod (this may require a very light tap with a mallet). Using an arbor press and the tool shown in Fig. 45, press the piston pin through the piston and connecting rod until the pin is centered in the piston.

**FIG. 43 Removing or Installing Piston Pin****FIG. 44 Piston, Connecting Rod and Related Parts**

3. Check the end gap of all piston rings (Part 21-01). It must be within specification. Follow the instructions contained on the piston ring package and install the piston rings.

4. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land (Part 21-01). The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. **If the lower lands have high steps, the piston should be replaced.**
5. Be sure the bearing inserts, the bearing bore and the mating surfaces on the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

CYLINDER ASSEMBLY (6009)

Disassembly

1. Remove the intake manifold, cylinder heads, front cover (with water pump attached), thermostat and housing, oil pressure and temperature sending units, fuel pump, flywheel, oil pan, oil pump and associated attaching parts from the old engine, using the procedures given in the Removal and Installation section of this Part.
2. Remove the dipstick tube, oil filter adapter and fuel pump retaining stud from the old block. Remove fasteners and components not received with the replacement cylinder block.

Assembly

1. Clean the gasket and seal surfaces of all parts and assemblies.
2. Position the replacement cylinder assembly in a work stand. Install the cylinder block drain plugs, cylinder head locating dowels, front and rear cover plate locating dowels, dipstick tube, oil filter adapter and fuel pump retaining stud.
3. Transfer all serviceable parts removed from the old cylinder assembly, following the installation

procedures given in the Removal and Installation section of this Part.

4. Check all assembly clearances and correct as necessary.

CYLINDER BLOCK (6010)

Before replacing a cylinder block, determine if it is repairable. If so, make the necessary repairs, following the procedures given in Part 21-01.

Disassembly

1. Disassemble the engine completely, following the various procedures given in the Removal and Installation section of this Part. Remember to remove any ridge or carbon deposit from the upper end of the cylinder bores before removing pistons.
2. Remove the temperature and oil pressure sending units from the old block, dipstick tube, oil filter adapter and fuel pump retaining stud.
3. Remove the old cylinder block from the work stand.

Assembly

1. Install the replacement cylinder block on the work stand. Install the temperature and oil pressure sending units, dipstick tube, oil filter adapter and fuel pump retaining stud. Remove fasteners and components not received with the replacement cylinder block.
2. Clean all the gasket and seal surfaces of all parts and assemblies before installing on the replacement cylinder block.
3. Transfer all serviceable parts removed from the old cylinder block to the replacement unit, using the procedures given in the Removal and Installation section of this Part.
4. Check all assembly clearances and correct as necessary.

SPECIFICATIONS

GENERAL SPECIFICATIONS	
DISPLACEMENT	5.8L/6.6L (351M/400 CID)
NUMBER OF CYLINDERS	8
BORE AND STROKE	4.00 x 3.50 5.8L (351 CID) 4.00 x 4.00 6.6L (400 CID)
FIRING ORDER	1-3-7-2-6-5-4-8
OIL PRESSURE (Hot @ 2000 RPM)	50-75
DRIVE BELT TENSION	①
CYLINDER HEAD AND VALVE TRAIN	
COMBUSTION CHAMBER VOLUME (cc)	76.9-79.9
VALVE GUIDE BORE DIAMETER	0.3433-0.3443
VALVE SEATS	
Width - Intake	0.060-0.080
Width - Exhaust	0.060-0.080
Angle	45°
Runout Limit (T. I. R. Max.)	0.002
VALVE ARRANGEMENT (Front to Rear)	(LH) I-E-I-E-I-E-I-E (RH) I-E-I-E-I-E-I-E
VALVE STEM TO GUIDE CLEARANCE	
Intake	0.0010-0.0027
Exhaust	0.0015-0.0032
Service Clearance	0.0055
VALVE HEAD DIAMETER	
Intake	2.032-2.050
Exhaust	5.8L (351M CID) 1.6635-1.6455 6.6L (400 CID) 1.6495-1.6595
VALVE FACE RUNOUT LIMIT	0.002 Max.
VALVE FACE ANGLE	44°
VALVE STEM DIAMETER(Std)	
Intake	0.3416-0.3423
Exhaust	0.3411-0.3418
(0.003 Oversize)	
Intake	0.3446-0.3453
Exhaust	0.3441-0.3448
(0.015 Oversize)	
Intake	0.3566-0.3575
Exhaust	0.3561-0.3568
(0.030 Oversize)	
Intake	0.3716-0.3723
Exhaust	0.3711-0.3718
VALVE SPRINGS (INTAKE)	
Compression Pressure (Lb. @ Spec. Length)	76-84 @ 1.82 215-237 @ 1.39
Free Length (Approximate)	2.06
Assembled Height	1-13/16-1-27/32
Service Limit	②
Out-Of-Square Limit	5/64 (0.078)
VALVE SPRINGS (EXHAUST)	
Compression Pressure (Lb. @ Specified Length)	79-87 @ 1.68 215-237 @ 1.39
Free Length (Approximate)	1.93
Assembled Height	1-13/16-1-27/32
Service Limit	②
Out-Of-Square Limit	5/64 (0.078)
ROCKER ARM	
Ratio	1.64:1
PUSH ROD RUNOUT (T. I. R. Max.)	0.015
VALVE TAPPET	
Diameter (Std)	0.8740-0.8745
Clearance To Bore	0.0007-0.0027
Service Limit	0.005
Hydraulic Leakdown Rate	5-50 Seconds ③
Collapsed Tappet Gap - Allowable	0.100-0.200
- Desired	0.125-0.175

CAMSHAFT	
LOBE LIFT	
Intake	0.235 5.8L (351 CID) 0.2474 6.6L (400 CID)
Exhaust	0.285 5.8L (351 CID) 0.2500 6.6L (400 CID)
Allowable Lobe Lift Loss	0.005 Max.
THEORETICAL VALVE LIFT @ ZERO LASH	
Intake	0.4065 5.8L (351 CID) 0.4280 6.6L (400 CID)
Exhaust	0.4065 5.8L (351 CID) 0.4325 6.6L (400 CID)
END PLAY	0.001-0.006
Service Limit	0.009
JOURNAL TO BEARING CLEARANCE	0.001-0.003
Service Limit	0.006
CAMSHAFT GEAR BACKLASH	0.006-0.010
JOURNAL DIAMETER	
# 1	2.1238-2.1248
# 2	2.0655-2.0665
# 3	2.0505-2.0515
# 4	2.0355-2.0365
# 5	2.0205-2.0215
Runout Limit	0.005
Out-Of-Round Limit	0.0005
CAMSHAFT BEARING INSIDE DIAMETER	
# 1	2.1258-2.1268
# 2	2.0675-2.0685
# 3	2.0625-2.0635
# 4	2.0375-2.0385
# 5	2.0225-2.0235
FRONT BEARING LOCATION ④	0.005-0.020
CYLINDER BLOCK	
HEAD GASKET SURFACE FLATNESS	⑤
HEAD GASKET SURFACE FINISH (RMS)	60-150
CYLINDER BORE	
Diameter	4.0000-4.0048
Surface Finish (RMS)	18-38
Out-Of-Round Limit	0.0015
Out-Of-Round Service Limit	0.005
Taper Service Limit	0.010
TAPPET BORE DIAMETER	0.8752-0.8767
MAIN BEARING BORE DIAMETER	3.1922-3.1930
DISTRIBUTOR SHAFT BEARING BORE DIAMETER	0.5160-0.5175

Drive Belt Tension (Lbs.)			
Size	Newly Installed (A)	Used	
		Up to 10 Min.	Over 10 Min.
1/4"	50-80	40-80 (B)	40-60 (B)
Exc. 1/4"	120-160	90-160 (C)	75-120 (D)

(A) Read tension immediately after belt is installed, before it stretches or seats in pulley grooves.

(B) If less than 40 pounds, readjust to 40-60 pounds.

(C) If less than 90 pounds, readjust to 90-120 pounds.

(D) If less than 75 pounds, readjust to 90-120 pounds.

② 10% pressure loss at specified length.

③ Time required to leak down 1/16" with 50 lb. load and lifter filled with leakdown fluid.

④ Distance Front edge of bearing is installed below front face of block.

⑤ 0.003 in any 6 inches - 0.006 overall.

CRANKSHAFT AND FLYWHEEL

MAIN BEARING JOURNAL DIAMETER	2.9994-3.0002
Out-Of-Round Limit	0.0006 Max.
Taper Limit	0.0006 Max.
Journal Runout Limit	0.002 Max.
Surface Finish (RMS)	12 Max.
Runout Service Limit	0.005

THRUST BEARING JOURNAL

Length	1.137-1.139
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CONNECTING ROD JOURNAL

Diameter	2.3103-2.3111
Out-Of-Round Limit	0.0006 Max.
Taper Limit	0.0006 Max.
Surface Finish (RMS)	12 Max.

MAIN BEARING THRUST FACE

Surface Finish	25 Front/20 Rear
Runout Limit	0.001 Max.

FLYWHEEL RING GEAR LATERAL RUNOUT (T. I. R.)

Automatic Transmission	0.060
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CRANKSHAFT FREE END PLAY

Service Limit	0.012
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CONNECTING ROD BEARINGS

Clearance To Crankshaft - Desired	0.0008-0.0015
- Allowable	0.0008-0.0025
Bearing Wall Thickness (Std.) (6)	0.0622-0.0625

MAIN BEARINGS

Clearance To Crankshaft - Desired	0.0008-0.0015
- Allowable	0.0008-0.0026
Bearing Wall Thickness (Std.) (6)	0.0955-0.0960

CONNECTING ROD, PISTON AND RINGS

CONNECTING ROD

Piston Pin Bore Diameter	0.9726-0.9742
Crankshaft Bearing Bore Diameter	2.4361-2.4369
Out-Of-Round Limit	0.0004 Max.
Taper Limit	0.0004 Max.
Length (Center-to-Center)	6.5785-6.5815
Alignment (Bore-to-Bore Max. Diff.) (7)	
Twist	0.024
Bend	0.024
Side Clearance (Assembled to Crank)	
Standard	0.010-0.020
Service Limit	0.023

PISTON

Diameter (8)	
Coded Red	3.9982-3.9988
Coded Blue	3.9994-4.0000
0.003 Oversize	4.0006-4.0012
Coded Yellow	4.0018-4.0024 6.6L (400 CID) Only
Piston-to-Bore Clearance	0.0014-0.0022
Pin Bore Diameter	0.9754-0.9757

CONNECTING ROD, PISTON AND RINGS (Continued)

Ring Groove Width	
Compression (Top)	0.080-0.081
Compression (Bottom)	0.080-0.081
Oil	0.168-0.189
PISTON PIN	
Length	3.150-3.170
Diameter	
Standard	0.9749-0.9754
0.001 Oversize	0.9763-0.9760
0.002 Oversize	0.9770-0.9773
Pin-To-Piston Clearance	0.0003-0.0005
Pin-To-Rod Clearance	Interference Fit
PISTON RINGS	
Ring Width	
Compression (Top)	0.077-0.078
Compression (Bottom)	0.077-0.078
Side Clearance	
Compression (Top)	0.002-0.004
Compression (Bottom)	0.002-0.004
Oil Ring	Snug Fit
Service Limit	0.006
Ring Gap	
Compression (Top)	0.010-0.020
Compression (Bottom)	0.010-0.020
Oil Ring (Steel Rail)	0.015-0.055

LUBRICATING SYSTEM

OIL PUMP

Relief Valve Spring Tension (Lbs. at Spec. Length)	20.6-22.5 @ 2.49
Drive Shaft-To-Housing Bearing Clearance	0.0015-0.0030
Relief Valve-To-Bore Clearance	0.015-0.0030
Rotor Assembly End Clearance (Assembled)	0.004 Max.
Outer Race-To-Housing Clearance	0.001-0.013
OIL CAPACITY (Quarts U. S.)	4 (9)

FUEL PUMP

STATIC PRESSURE (P.S.I.) (10)	6.0-8.0
MINIMUM VOLUME FLOW (10) (11) (12)	1 Pint in 20 Seconds
ECCENTRIC TOTAL LIFT (Inches)	0.602-0.622

(6) For 0.002 Undersize, add .001 to Standard Thickness.

(7) Pin bore and crank bearing bore must be parallel and in same vertical plane within the specified total difference when measured at the ends of an 8" bar - 4" on each side of rod centerline.

(8) Measured at the piston pin bore centerline @ 90° to the pin.

(9) Add 1 quart with filter change.

(10) On engine, normal temperature, curb idle, transmission in neutral.

(11) No orifice in test circuit smaller than 0.220" i. D.

(12) With new filter; pump to tank return line pinched off.

CA1309-2F2

TORQUE SPECIFICATIONS

CAMSHAFT SPROCKET TO CAMSHAFT	10-45
CAMSHAFT THRUST PLATE TO BLOCK	9-12
CONNECTING ROD NUTS OR BOLTS	40-45
CYLINDER FRONT COVER BOLTS	12-18
CYLINDER HEAD BOLTS	13
DAMPER OR PULLEY TO CRANKSHAFT	70-80
DISTRIBUTOR VACUUM CONTROL VALVE	10-15
EGR TO CARBURETOR SPACER OR INT. MANIFOLD	12-18
FUEL PUMP TO CYLINDER BLOCK OR FRONT COVER	Nut = 14-20 Bolt = 10-15
FLYWHEEL TO CRANKSHAFT	75-85
MAIN BEARING CAP BOLTS	95-105
MANIFOLD TO CYLINDER HEAD (Intake)	3/8 = 22-32 5/16 = 18-25
MANIFOLD TO CYLINDER HEAD (Exhaust)	18-24
OIL FILTER INSERT TO CYLINDER BLOCK	20-30
OIL FILTER TO BLOCK OR ADAPTER	14
OIL PAN DRAIN PLUG	15-25
OIL PAN TO CYLINDER BLOCK	5/16 = 11-13 1/4 = 7-9
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ROCKER ARM STUD OR BOLT TO CYLINDER HEAD	18-25
SPARK PLUG TO CYLINDER HEAD	10-15
VALVE ROCKER ARM COVER	3-5
ALTERNATOR BRACKET TO CYLINDER BLOCK (Bolt)	15-20
ALTERNATOR PIVOT BOLT	45-57
ALTERNATOR ADJUSTING ARM TO CYLINDER BLOCK	15-20
ALTERNATOR ADJUSTING ARM TO ALTERNATOR	240
THERMATOR PUMP BRACKET TO CYLINDER BLOCK	15-20
THERMATOR PUMP PIVOT BOLT	35-45
THERMATOR PUMP ADJUSTING ARM TO PUMP	22-32
THERMATOR PUMP ADJUSTING ARM TO CYLINDER BLOCK	15-20
THERMATOR PUMP PULLEY TO SHAFT	130-180 in. lb.
POWER STEERING PUMP PULLEY TO DAMPER (Bolt)	35-50
FAN TO WATER PUMP HUB (Bolt)	12-18

TORQUE SPECIFICATIONS (Continued)

CARBURETOR MOUNTING NUTS	12-15
CARBURETOR MOUNTING STUD	17
TORQUE SPECIFICATIONS General Applications	
U.S. THREAD SIZES	TORQUE
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5/16-18	12-10
5/16-24	13-20
3/8-16	27-22
3/8-24	27-25
7/16-14	10-55
7/16-20	30-60
1/2-13	55-80
METRIC THREAD SIZES	TORQUE
M-6	6-9
M-8	11-21
M-10	28-40
M-12	50-71
M-14	80-111
PIPE THREAD SIZES	TORQUE
1/8	5-8
1/4	12-18
3/8	27-33
1/2	25-35

• All values are in ft. lb. unless otherwise noted.

• Oil threads with engine oil unless fasteners require sealers.

13. Torque in sequence: Step 1 75, Step 2 95-105.

14. 1/2 turn after contacting sealing surface with oiled gasket.

CA1309-2F3

7.5L (460 CID) Passenger and Police Interceptor V-8 Engines

PART
21-24

Ford, Mercury, Lincoln Continental and Continental Mark V

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION		REMOVAL AND INSTALLATION (Cont'd.)	
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Engine	24-1	Oil Filter	24-22
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Camshaft	24-15	Pistons and Connecting Rods	24-19
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Crankcase Ventilation System	24-6	Stem Seal	24-7
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Front Oil Seal	24-15		
Intake Manifold	24-8		

CN4036-2B

DESCRIPTION

ENGINE

The 7.5L (460 CID) V-8 engine (Fig. 1) is a lightweight cast iron design. The Police Interceptor version is basically the same engine except for durability items such as the crankcase oil cooler and performance items such as revised camshaft specifications. All operations in this Part apply to both engines unless otherwise specified.

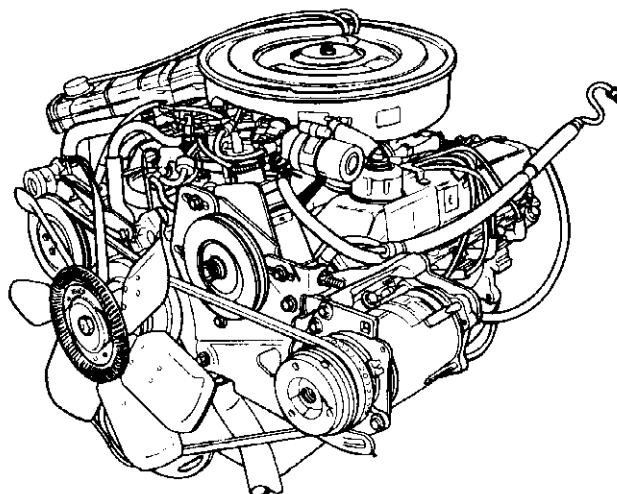
EXHAUST EMISSION CONTROL SYSTEM

Operation, removal, installation and required maintenance of the exhaust emission control devices

used on this engine are covered in Group 29 and Group 50 of this Manual.

CRANKCASE VENTILATION SYSTEM

The 7.5L (460 CID) V-8 engines have a positive closed-type crankcase ventilation system recycling the crankcase vapors to the intake manifold.



A2976-1D

FIG. 1 3/4 Left Front View—7.5L (460 CID) V-8 Engine

REMOVAL AND INSTALLATION

CAUTION: Do not operate the engine with the hood open until the fan has been first examined for possible cracks and separation.

When installing nuts or bolts that must be torqued (refer to torque specifications), oil the threads with light-weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.**

Refer to Part 21-01 for Cleaning, Inspection and Test procedures.

ENGINE

The engine removal and installation procedures are for the engine, without the transmission attached. Remove or disconnect Thermactor parts that will interfere with removal or installation of the engine.

Removal

1. Raise the hood and mask the edges of the hood, fenders and cowl to protect the paint. Place fender covers on fenders.
2. Remove the hood.
3. Drain the cooling system at the radiator and the cylinder block.
4. Disconnect the ground cable from the battery. Remove the air cleaner and intake duct assembly. Cover the carburetor air horn with a clean cloth.
5. Disconnect the radiator upper and lower hoses at the engine. Disconnect the transmission oil cooler lines at the radiator. On Police Interceptor models, disconnect engine oil cooler water hoses at oil cooler.

CAUTION: Use 2 wrenches when disconnecting hoses to avoid damaging hose from twisting.

6. Remove the fan shroud attaching bolts.
7. Remove the cooling fan-to-water pump hub attaching bolts. Remove the cooling fan and the shroud.
8. Remove the radiator upper support and the radiator.
9. If equipped with air conditioning, purge the system of freon. Remove the clamp bolt at the air conditioner muffler support if so equipped and position the refrigerant lines out of the way.

Loosen the compressor adjustment and remove the drive belt. Remove the compressor support bracket-to-water pump bolt. Remove the compressor-to-mounting bracket bolts. Remove the power steering pump and position it to one side. Disconnect the compressor clutch wire and remove the compressor. Remove the compressor mounting bracket and idler pulley.

10. Disconnect the fuel inlet line at the fuel pump. Plug or cap the line to prevent fuel loss. Disconnect the fuel return line.
11. Loosen the alternator adjusting arm and mounting bolts. Remove the drive belts and water pump pulley. Remove the alternator and mounting brackets and position out of way, leaving the wires connected.
12. Disconnect the ground cable at the right front corner of cylinder block. Disconnect the heater hoses. Remove the transmission fluid filler tube attaching bolt from the right valve rocker arm

cover, and position the transmission filler tube out of the way.

13. Disconnect all vacuum lines at the rear of intake manifold.
14. Disconnect the speed control at carburetor if so equipped. Disconnect the accelerator cable and secure out of way.
15. Disconnect the engine wiring harness at the multi-connector on dash.
16. Raise the vehicle on a hoist. Disconnect the inlet pipes at exhaust manifolds. On Police Interceptor models, disconnect engine oil cooler hoses from oil filter adaptor and plug hoses.

CAUTION: Use 2 wrenches when disconnecting hoses to avoid damaging the hoses from twisting.

17. Disconnect the starter cable from starter solenoid or starter. Remove starter attaching bolts and remove starter by moving starter assembly forward, rotating it to turn solenoid outward, then removing it toward rear of vehicle.
18. Remove access cover from converter housing. Remove the flywheel to converter attaching nuts, rotating the flywheel as necessary. Remove the converter-to-engine lower rear cover plate attaching bolts.
19. Remove the nuts attaching the front support insulators to the underbody crossmember.
20. Hold the transmission in position with a support tool.
21. Lower the vehicle on hoist. Remove converter housing to cylinder block upper attaching bolts (left side). Disconnect the coil wiring harness, and remove the coil and bracket assembly from the intake manifold.
22. Attach an engine lifting sling, Tool No. T53L-300-A, hoist and lifting brackets to intake manifolds. Carefully remove engine from the vehicle. Install the engine on a work stand and remove the lifting sling.

Installation

1. Attach engine lifting sling, Tool No. T53L-300-A, hoist and lifting brackets to intake manifolds. Remove engine from work stand.
2. Carefully lower engine into vehicle. With engine supported by lifting sling, align converter-to-flywheel mounting studs with flywheel. Position the engine support insulator heat shields, then lower the engine, guiding the front support insulator studs into holes in underbody crossmember.
3. Install the converter housing-to-cylinder block upper attaching bolts and torque to specification. Remove the transmission support. Position the hoist out of the way and remove lifting sling.
4. Raise the vehicle on a hoist and install the front support insulator stud nuts. Torque them to specification. Install the converter housing-to-engine rear cover plate lower attaching bolts and torque them to specification.
5. Install the nuts on converter-to-flywheel mounting studs and torque nuts to specification. Install converter access plate.

6. Install the starter and connect starter cable.
7. With gaskets in place on inlet pipes, guide pipe ends into exhaust manifold flanges. Install nuts on flange studs and torque to specifications. On Police Interceptor models, connect engine oil cooler hoses to oil filter adaptor. Make sure and observe color codes on adaptor and hoses (Fig. 2).

CAUTION: Use 2 wrenches when disconnecting hoses to avoid damaging the hoses from twisting.

8. Lower the vehicle and connect accelerator cable. Connect engine wiring harness at multi-connector at dash.
9. Connect all vacuum lines at rear of intake manifold. Connect speed control chain, if so equipped, to carburetor linkage.
10. Connect heater hoses. On Police Interceptor models, connect coolant hoses to engine oil cooler on left fender apron. Torque clamps to specifications.

CAUTION: Use 2 wrenches when disconnecting hoses to avoid damaging hose from twisting. Set transmission filler tube in position and tighten bolt at right valve rocker arm cover to secure tube.

11. Connect ground wire to right front corner of cylinder block. Install alternator and mounting brackets.
12. If equipped with air conditioning, install the compressor upper mounting bracket to left cylinder head. Position the air conditioner muffler bracket and power steering reservoir or pump on studs in left cylinder head. Install compressor to upper mounting bracket and attach compressor support bracket to water pump. Connect compressor clutch wire bullet connector.
13. Connect the fuel inlet line and fuel return line to the fuel pump. Install the coil to intake manifold and connect wires.
14. If equipped with air conditioning, connect the service valves to compressor and install air conditioner muffler.
15. Set radiator in position and install the radiator upper support. Install the radiator upper and lower hoses. Connect the oil cooler lines to radiator.
16. Fit the water pump pulley in position. Install all drive belts.
17. Place fan assembly inside radiator shroud and position the shroud. Install fan assembly to water pump hub and torque bolts to specification. Install the shroud attaching bolts.
18. Fill the crankcase, cooling system and power steering reservoir to the correct level with specified lubricants. Adjust the tension of drive belts to specification.
19. Connect the distributor and vacuum lines. Install the air cleaner and intake duct, crankcase ventilation system air supply hose and oil filler cap.
20. Connect the battery. Start the engine and check for leaks.
21. When engine temperature stabilizes, adjust the ignition timing, engine idle speed and mixture, and transmission linkage, as required.

22. If equipped with air conditioning, recharge the system.
23. Install the hood. Remove the masking tape and fender covers.

CRANKCASE OIL COOLER (POLICE INTERCEPTOR)

Removal

1. Drain the cooling system.
2. Disconnect the water coolant lines from the oil cooler (Fig. 2).
3. Disconnect the oil cooler inlet and outlet hoses.
4. Remove the one nut and one capscrew that attaches the front support to the front strap.
5. Remove the two nuts that attach the oil cooler to the rear strap.
6. Remove the two screws that attach the front support bracket to the oil cooler and remove the bracket.

Installation

1. Install the front support bracket on the oil cooler with the top end as shown in Fig. 2 to fit the contour of the fender apron.
2. Position the oil cooler on the fender apron and install the three attaching nuts and one bolt.
3. Connect the oil inlet hose to the rear of the cooler and torque it to specification. Connect the oil outlet hose to the front of the cooler and torque it to specifications. Use two wrenches when tightening. Be careful not to bend the hoses in a tight radius. The teflon liner in the hose could be crimped or

twisted causing an oil leak or obstruction if bent too sharply.

4. Connect the water inlet hose to the upper fitting on the oil cooler and the outlet hose to the lower fitting. Tighten the hose clamps.
5. Fill the cooling system with the specified coolant.
6. Check the oil level and fill to the proper level with the specified oil.
7. Start the engine and bleed the cooling system. Check for oil and coolant leaks.

OIL FILTER ADAPTER

Removal

1. Remove the oil filter.
2. Disconnect the oil cooler inlet and outlet hoses from the oil filter adaptor (Fig. 2).
3. Remove the oil filter adaptor attaching bolt and gasket. Remove the adaptor and mounting gasket from the cylinder block.

Installation

1. Clean all old gasket material from the cylinder block.
2. Position a new mounting gasket with the rib in the horizontal position and the rib of the adapter in the vertical position (Fig. 2).
3. Install a new gasket and the adapter attaching bolt. Tighten the attaching bolt to specification.
4. Connect the oil cooler inlet hose and the outlet hose to the adapter making sure that the paint mark on each hose is matched with that on the adapter and that they are in alignment.

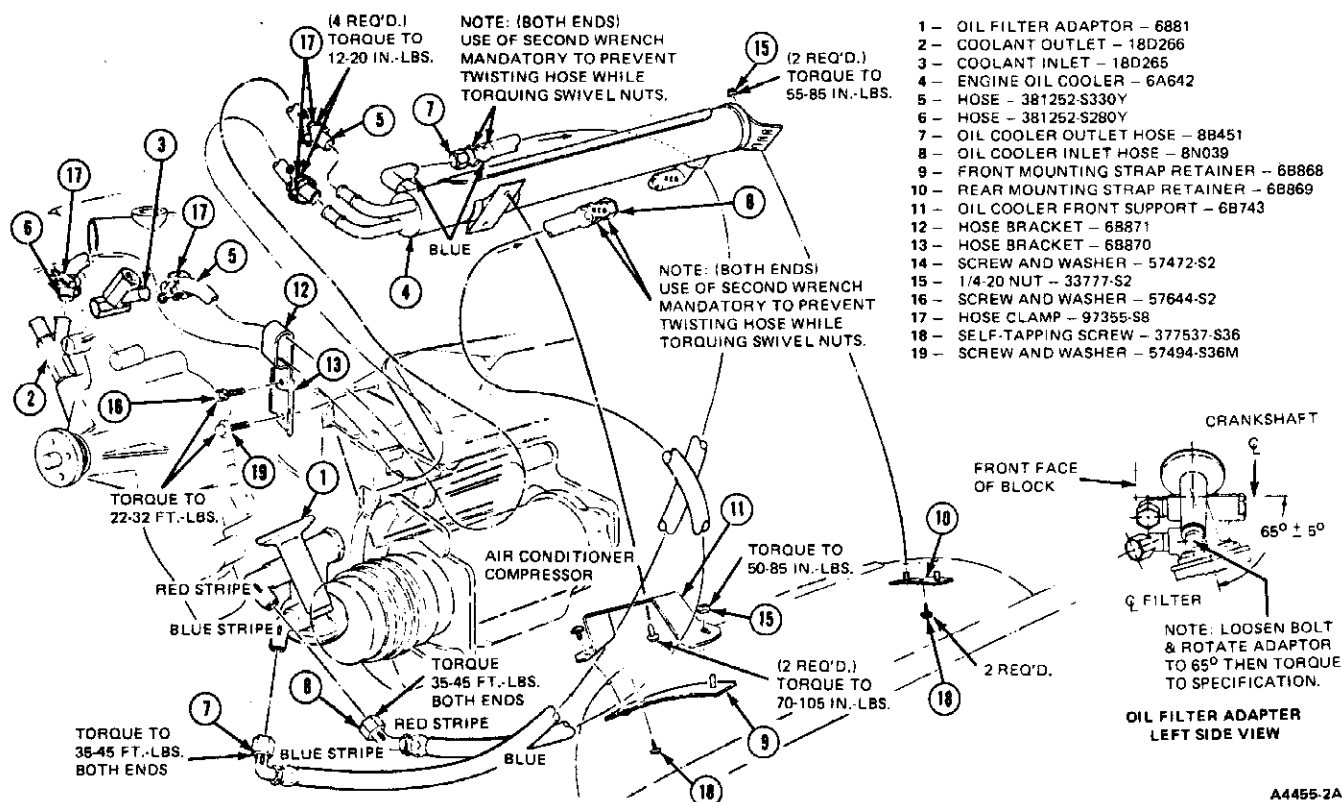


FIG. 2 Engine Oil Cooler Installation—Ford/Mercury Police Interceptor—A/C Shown

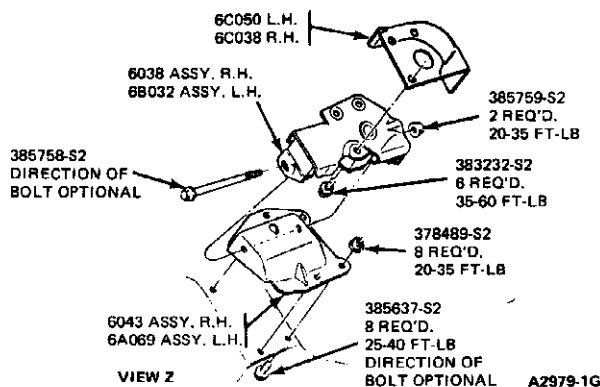


FIG. 3 Engine Front Support—Ford and Mercury

5. Install a new oil filter element.
6. Fill the crankcase to the correct level with the specified oil.
7. Start the engine and check for oil leaks.
8. Recheck oil level after running and add oil as necessary to obtain correct level.

ENGINE FRONT SUPPORTS

Front supports (Figs. 3 through 5) are located on each side of the cylinder block. Following procedures apply to either support.

When self-locking fasteners (marked * in following Figs.) are removed, they must be replaced with new self-locking fasteners.

FORD, MERCURY, LINCOLN CONTINENTAL AND CONTINENTAL MARK V

Removal

1. Remove the fan shroud attaching bolts, leaving the fan shroud loose in the vehicle.
2. Remove the through bolt and nut attaching the insulator to the insulator support bracket and/or the No. 2 crossmember. Remove the through bolts on both mounts at the same time.
3. Using a jack and wood block placed under the oil pan, raise the engine approximately 1 to 1-1/2 inches, allowing the insulator locator stud, if present, to disengage from the locator hole in the bracket crossmember.
4. Remove the bolts attaching the insulator assembly to the engine block. Remove the insulator assembly and heat shield, if so equipped.

Installation

1. Position the insulator assembly and heat shield, if so equipped, on the engine block. Install the attaching bolts and torque to specification.
2. Lower the engine into place and align the through bolt holes on the insulator assembly with those on

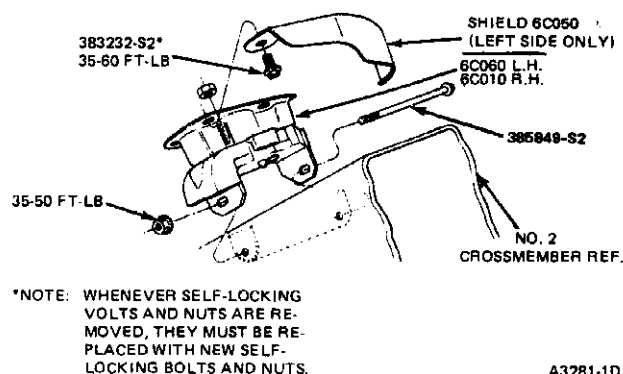


FIG. 4 Engine Front Support—Lincoln Continental

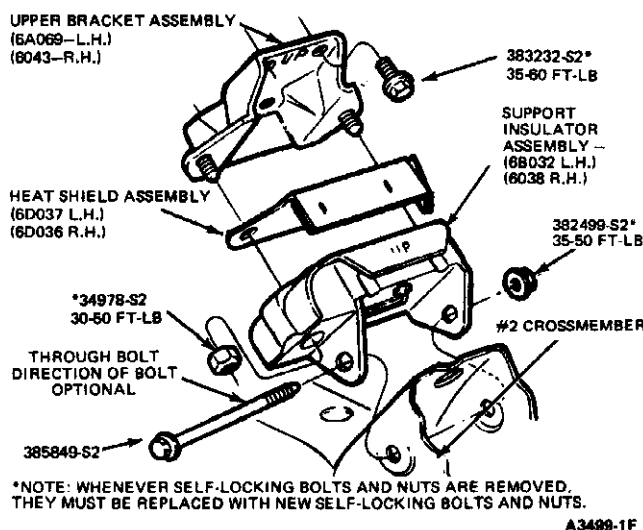


FIG. 5 Engine Front Support—Continental Mark V

the support bracket or crossmember. Install the through bolt. Remove jack and wood block. Torque through bolt and nut to specification.

3. Install the fan shroud retaining bolts and torque to specification.

ENGINE REAR SUPPORT

Engine rear supports (Figs. 6 and 7) are located between the transmission extension housing and the vehicle crossmember.

Whenever self-locking fasteners (marked * in following Figs.) are removed, they must be replaced with new self-locking fasteners.

FORD, MERCURY, LINCOLN CONTINENTAL AND CONTINENTAL MARK V

Removal

1. Remove the nuts (and through bolt where applicable) attaching the insulator to the No. 3 crossmember.
2. Raise the transmission with a jack to obtain clearance.
3. Remove the bolts and washers that attach the rear insulator assembly to the transmission.
4. Remove the insulator assembly.

Installation

1. Position the rear insulator assembly on the transmission. Install the attaching bolts and washers and torque to specification.
2. Lower transmission into position.
3. Install the nuts (and through bolts where applicable) attaching the insulator assembly to the crossmember. Torque to specification.
4. Remove the jack supporting the transmission.

CRANKCASE VENTILATION SYSTEM (FIG. 8)

Removal

1. Remove ventilation system air intake hose from air cleaner. Remove the hose, elbow and grommet from the left rocker arm cover.
 2. Remove air cleaner and intake duct assembly.
 3. Disconnect the inlet vent hose and tube from the carburetor.
- Unlock and remove the oil filler cap.
4. Pull PCV valve out of mounting grommet in right valve rocker arm cover and remove inlet vent hose and PCV valve as an assembly. Disassemble as necessary.

Installation

1. Install the oil filler cap. Insert the regulator (PCV) valve into the right rocker arm cover grommet.
2. Reassemble vent tubes and hoses to canister purge tee and hose. Position the inlet vent hose and tube and connect to carburetor and PCV valve.
3. Install air cleaner and intake duct assembly.
4. Install ventilation system air intake hose, elbow and grommet to air cleaner and oil filler cap.

VALVE ROCKER ARM COVER AND ROCKER ARM

The valve rocker arm and attaching parts are shown in Fig. 9.

Removal

1. Remove the air cleaner and intake duct assembly.
- If a right cylinder head rocker arm is to be removed, remove the crankcase ventilation regulator valve from the valve rocker arm cover.
2. Disconnect the spark plug wires from the spark plugs by grasping, twisting and pulling the moulded cap only with Tool T74P-6666-A. Remove the wires from the bracket on the valve rocker arm cover(s) and position the wires out of the way.

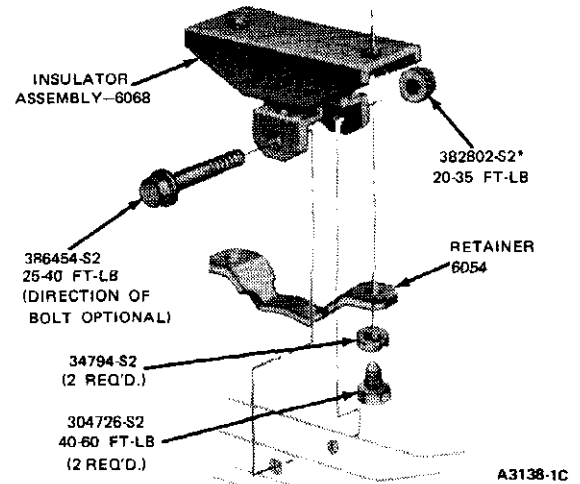


FIG. 6 Engine Rear Support—Ford and Mercury

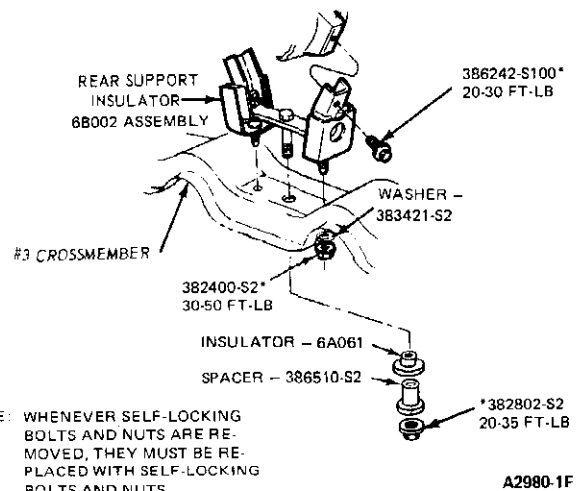


FIG. 7 Engine Rear Support—Continental Mark V

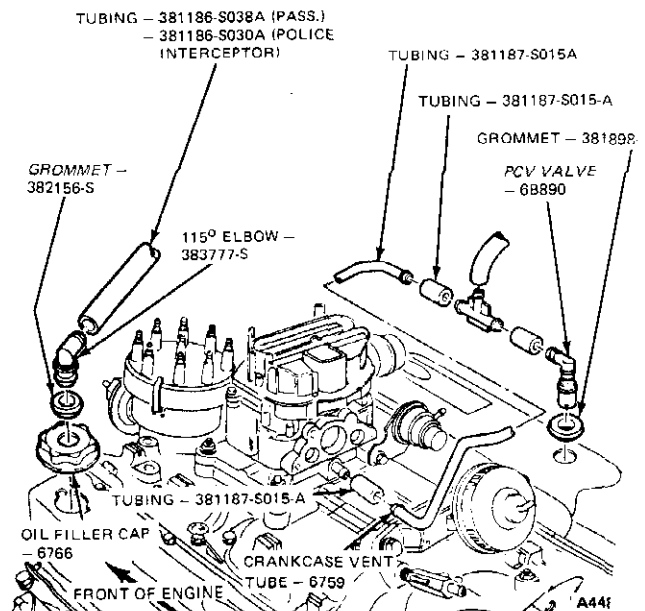


FIG. 8 PCV System

3. Remove the valve rocker arm cover(s).
4. Remove the valve rocker arm bolt, oil deflector, fulcrum seat and rocker arm.

Installation

1. Apply Lubriplate or equivalent to the top of the valve stems, the rocker arm and fulcrum seats.
2. Position the No. 1 piston on TDC at the end of the compression stroke in position 1 in Fig. 10 and install the rocker arm, fulcrum seat, oil deflector and bolt on the following valves:

No. 1 Intake No. 1 Exhaust

No. 7 Intake No. 5 Exhaust

No. 8 Intake No. 4 Exhaust

Position the crankshaft in position 2 in Fig. 10 and install the rocker arm, fulcrum seat, oil deflector and bolt on the following valves:

No. 4 Intake No. 2 Exhaust

No. 5 Intake No. 6 Exhaust

Position the crankshaft in position 3 in Fig. 10 and install the rocker arm, fulcrum seat, oil deflector and bolt on the following valves:

No. 2 Intake No. 3 Exhaust

No. 3 Intake No. 7 Exhaust

No. 6 Intake No. 8 Exhaust

Be sure that the fulcrum seat base is inserted in its slot on the cylinder head before tightening the fulcrum bolts. Tighten the fulcrum bolt to specification. Check the valve clearance following the procedures in Part 21-01 under Valve Clearance Adjustment.

3. Clean the valve rocker arm cover(s) and the cylinder head gasket surface(s). Position the new gasket in the cover, making sure that the gasket tangs are secured in the notches in the cover.
4. Position the cover(s) on the cylinder head(s). Make sure the gasket seats evenly all around the head. Install the bolts. The cover is tightened in two steps. Tighten the bolts to specification. Two minutes later, tighten the bolts to the same specification.

If the right cover was removed, install the PCV valve.

Install the air cleaner and intake duct assembly and connect the PCV system.

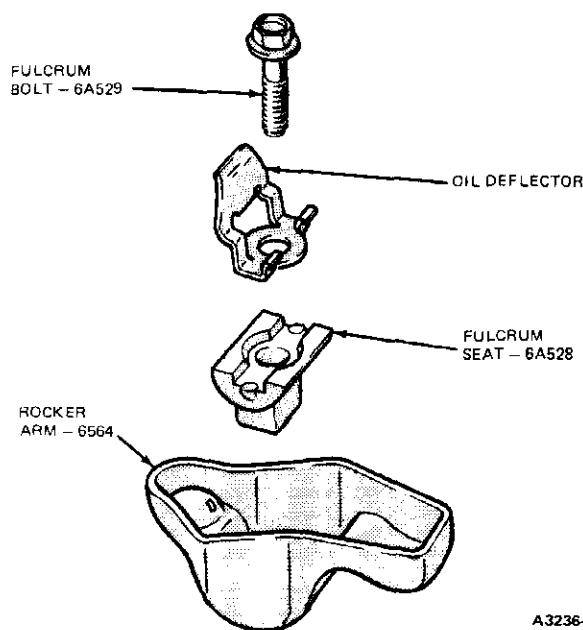
5. Install the spark plug wires in the bracket on the valve rocker arm cover(s). Connect the spark plug wires. See Part 23-01 for special installation instructions.
6. Start the engine and check for leaks.

VALVE SPRING, RETAINER AND STEM SEAL

Broken valve springs or damaged or worn valve stem seals or retainers may be replaced without removing the cylinder head if valve or valve seat is not damaged.

Removal

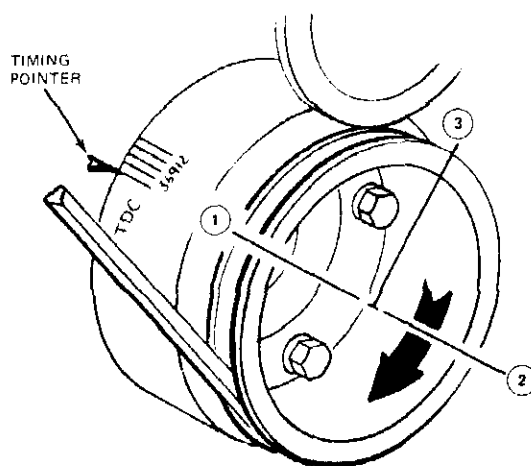
1. If damaged or worn spring, retainer, or seal is on right side of engine, remove air cleaner and intake duct assembly. Remove crankcase ventilation system PCV valve and attachments from right valve rocker arm cover. Remove spark plug wires.



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FIG. 9 Rocker Arm and Attaching Parts

With No. 1 at TDC at end of compression stroke make a chalk mark at points 2 and 3 approximately 90 degrees apart.



POSITION 1 — No. 1 at TDC at end of compression stroke.

POSITION 2 — Rotate the crankshaft 180 degrees (one half revolution) clockwise from POSITION 1.

POSITION 3 — Rotate the crankshaft 270 degrees (three quarter revolution) clockwise from POSITION 2.

A3234-1D

FIG. 10 Position of Crankshaft for Installing Valve Rocker Arms

If spring, retainer, or seal to be removed is on left side of engine, remove oil filler cap and ventilation hose from left valve rocker arm cover and position out of way.

2. Remove valve rocker arm cover(s) and applicable spark plug(s).